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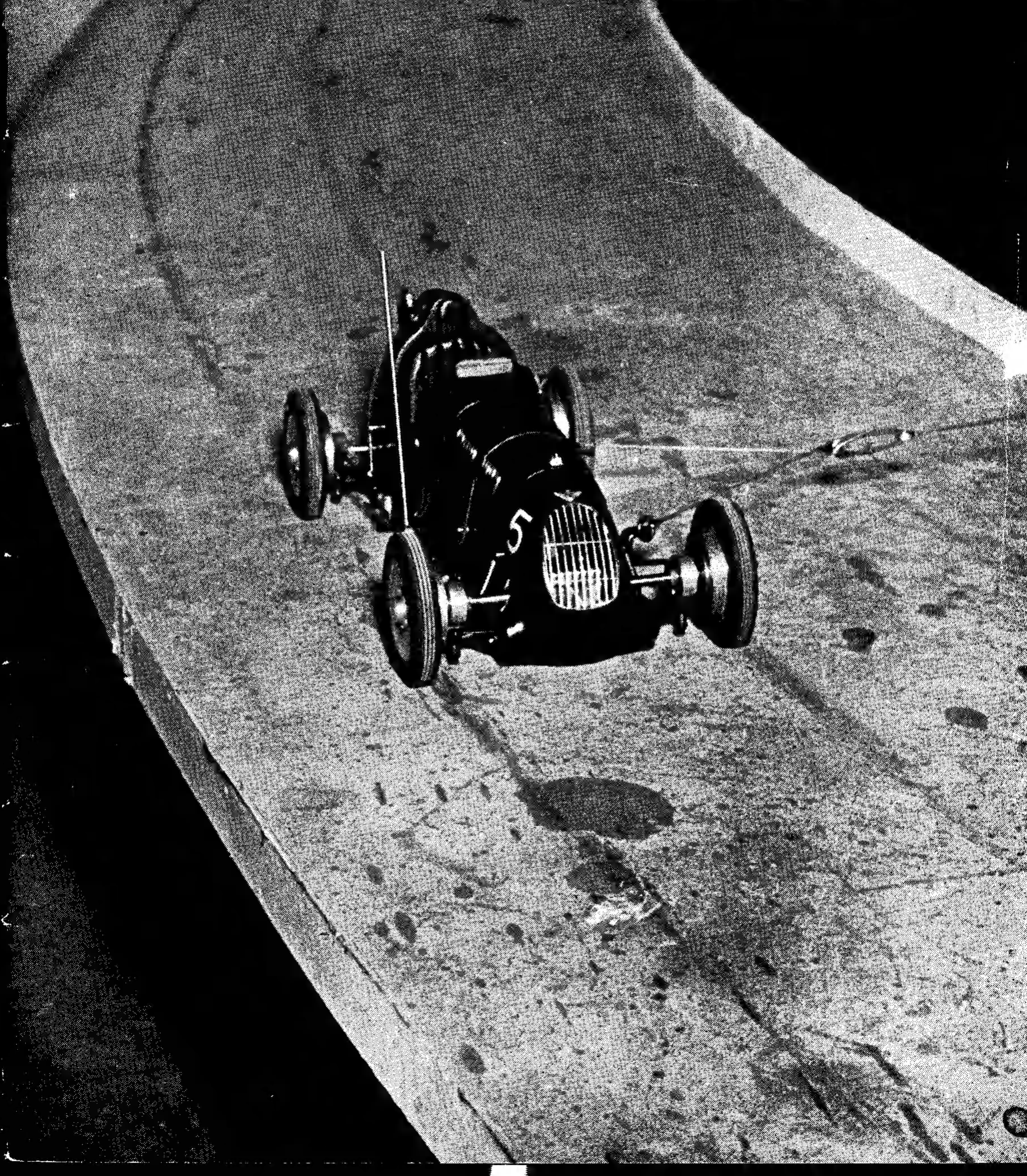
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

15TH MARCH 1951 VOL. 104 NO. 2599

SMOKE RINGS

Our Cover Picture

● MANY READERS will remember the circular track which was a feature of past MODEL ENGINEER Exhibitions, but few will have had the opportunity actually to study a car at speed on this circuit.

Here you see a semi-scale twin-cam Austin "stopped" by the camera as it hurtles round at a fast gallop. Good suspension and weight distribution enabled it to remain in contact with a surface which, by racing standards, would be considered "rough."

Another Rotary Club Exhibition

● THE ROTARY CLUB of Teddington has advised us that it has organised the Hobbies Exhibition now being held at the Public Rooms, York House, Twickenham, until March 17th. It is open from 3 p.m. till 10 p.m. each day, except the last when the doors will open at 11 a.m.

The object is to introduce and stimulate the interest of the public in all kinds of hobbies, through the medium of clubs and societies. The Malden and District S.M.E., the Surrey Model Car Club, the Thames Valley Amateur Radio and Broadcasting Society and the Bushy Park Model Flying Club, as well as the Society of Ornamental Turners, are all collaborating in the exhibition.

Newark Society Founded

● WE ARE glad to learn that a model engineering society has been successfully launched in Newark. At present, there are about 20 members, some of whom are building locomotives, ranging from 2½-in. to 7¼-in. gauge. The society, which is called the Newark and District Model and Experimental Engineering Club, does not yet possess its own workshop, but would welcome more members. The hon. secretary, Mr. P. W. Leath, 7, London Road, Newark, Notts, will be glad to hear from anyone interested in joining the club. Meanwhile, we wish the new venture all possible success and hope to hear of it frequently in the future.

Handicraft Teachers' Easter Exhibition

● THE INSTITUTE of Handicraft Teachers is holding its annual national conference this year at Hendon Technical College, The Burroughs, N.W.4, from Saturday, March 24th until Wednesday, 28th inclusive. An exhibition of all kinds of handicrafts will be included; it will be open to the public from 1.30 to 4.30 p.m. on the Saturday, Monday and Tuesday, and from 9.30 a.m. to 4.30 p.m. on the Wednesday. Admission free. The nearest station is Hendon Central, L.P.T.B., which is also served by buses 83 and 143.

Demonstrating Craftsmanship

● WE HEAR that, in connection with the Lincolnshire County Agricultural Show this year, the diocesan committee are hoping to provide some significant and unusual exhibits in the diocesan tent. It is suggested that a model of Lincoln Cathedral's central tower be shown, and, in addition, there shall be demonstrations of hand-bell-ringing. Also, it is hoped that a mason and a glazier from the cathedral shall be in attendance and each engaged in his craft.

These are ideas which are to be very highly commended, in our opinion; no better means exist for stimulating an interest in craftsmanship for its own sake, always a supreme attraction to the public. We know this from our own experience at the "M.E." exhibition; practical demonstrations of such crafts as glass-blowing, glass-cutting, smithing and wood-carving never fail to fascinate the public, and the more that can be shown of such crafts the better.

The Talyllyn Railway

● THIS HISTORIC railway is now the oldest surviving steam-hauled, passenger-carrying, narrow-gauge line in the world. Authorised by Act of Parliament in 1865, and still possessing its original locomotives and rolling stock, it is also one of the very few independently owned railways surviving in Britain.

Following the death of its owner and manager in July last, it became clear that this unique railway would close down unless some help was forthcoming and for this reason the Talyllyn Railway Preservation Society was formed. The object of the society is to ensure the survival of the line, its locomotives and stock, not as lifeless museum exhibits, but as a going concern.

After discussion with the society, the executors of the late owner have most generously agreed to transfer the ownership and administration of the railway company to a non-profit-making organisation, and details of this arrangement are now in process of being settled to the satisfaction of both parties. This most co-operative gesture on the part of the executors means that the funds which the society hope to raise by subscription can be wholly devoted to overtaking arrears of maintenance and to providing additional rolling stock.

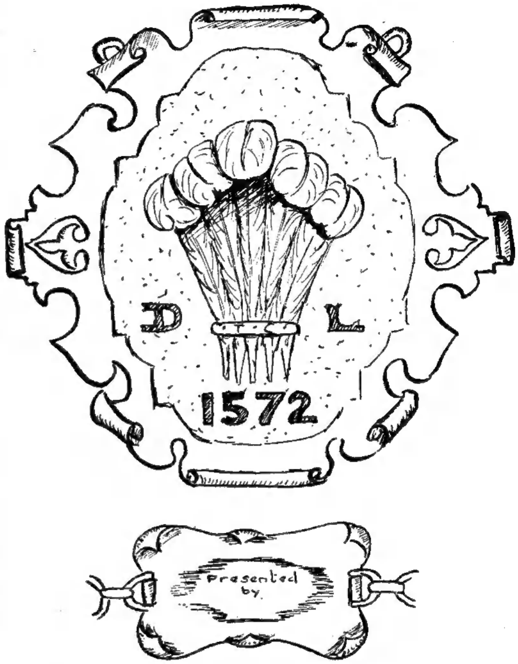
Last season the railway was able to show a small profit on working despite the fact that train accommodation was inadequate and that, having only one workable locomotive, it was only possible to maintain a three days per week service. The society aim to overcome these difficulties by presenting the company with a standby locomotive and additional stock which will enable an adequate six-day service to be worked next season. In addition, costly repairs to the track must be carried out before the line can re-open.

This is a unique and unrepeatable opportunity for the thousands of railway enthusiasts in this country to show and to realise their enthusiasm in tangible form by joining the society and subscribing generously to its funds. The committee of the society are relying upon the co-operation of all lovers of railways to enable them to realise their objective and keep the wheels turning on the Talyllyn Railway.

Full particulars of membership can be obtained from Patrick J. Garland, A.C.A., 36, Waterloo Street, Birmingham, 2.

A Novel Presentation

● MRS. VIOLA BARWELL, hon. secretary of the East Grinstead and District Model and Experimental Engineering Society, has sent us a sketch which is reproduced herewith; it depicts a handsome piece of work being made in what, to us,



are decidedly unusual circumstances. Mrs. Barwell writes: "We have designed for the East Grinstead Urban District Council a Badge of Office which we are making in silver and blue enamel. This we are presenting to the chairman of the U.D. Council at our exhibition on March 31st. It is entirely the work and gift of the society; the sketch shows the badge and the link designed to match."

We think that this badge must be a very handsome piece of work; if the original sketch is full size, the badge is 5 in. in width and height, and the link is approximately $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. We wonder if any other official Badge of Office has been made in similar circumstances. This one should certainly be a credit to the members of the East Grinstead M.E.E.S. as well as to the U.D. Council.

Incidentally, some unusual items at the forthcoming exhibition will be: a puppet show; a working, *steam*-operated model railway and a traction engine, which Mr. Norman Pearson is racing against time to complete, for passenger-hauling during the exhibition. The show opens on Thursday, March 29th and lasts until Saturday, 31st. Entry forms are obtainable from Mrs. Barwell, 9, Copse Close, East Grinstead.

Recording the Result

by L. C. Mason

WHEN you read in THE MODEL ENGINEER a detailed description of a model or a workshop project, a photograph or two not only adds interest, but greatly helps the text.

Occasionally such photographs are not all they might be. In looking at them, you wonder —is that an adjustment slot or the shadow of a screw-head? Is that con-rod fluted or plain? The photograph is perhaps not quite clear enough for you to be certain, and the text may not mention that particular point.

A picture of this kind is a disappointment all round. It does your model less than justice; it doesn't show others the care that has gone into the detail work; it diminishes the interest others might take in the job, and the block-maker has to do his best with an unsatisfactory job from the start.

It is perfectly possible for the model engineer "non-photographer" to take photographs which will reproduce all the visible details clearly.

What sort of camera to use? Any sort, though some are admittedly more suitable than others. An old plate camera—preferably "double extension"—is by far the best. This will have a ground glass screen on which you can focus exactly and see just what you will be getting on

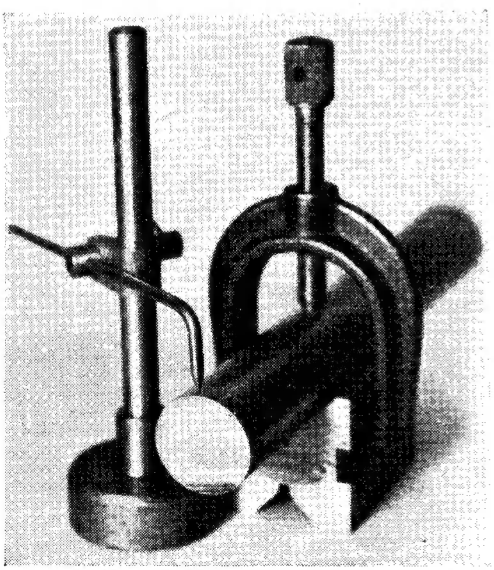


Fig. 1. Taken much too close, and with too large an aperture

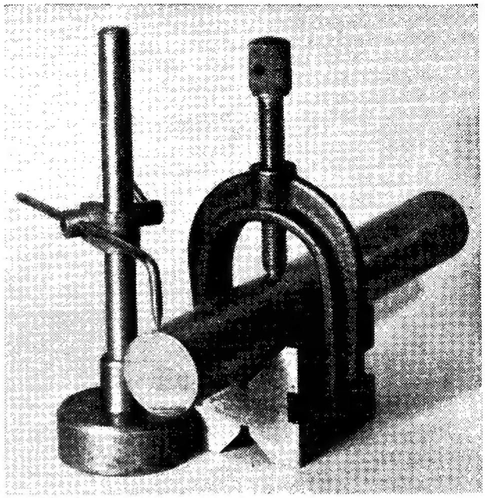


Fig. 2. Taken much farther away and stopped well down

the negative. "Double extension" means that the lens can be racked out to twice the distance from the plate as it would normally be when in the "infinity" position. This extra extension enables you to focus sharply on items only a few inches away, and is a valuable feature when close-ups of part of a subject are required, that locomotive boiler back-head, for example.

For cameras which haven't a focussing screen—the ordinary folding ones, twin-lens reflexes and boxes—fix up a temporary focussing screen of ground glass, held in the plane of the film by a couple of rubber bands, and see exactly what you get when the image is sharply focussed with the camera as near to the subject as you can get. Measure the subject to lens distance exactly, so that you can keep to that distance when it comes to the actual shooting.

In close-ups of this type, the normal view-finder will mislead when it comes to aiming the camera. This is because the line of vision through the finder is not the same as that through the centre of the lens. This is the "Parallax" effect, and it can be overcome by aiming along the middle of two adjacent sides of the camera. This does not arise in the case of plate cameras focussing on a glass screen, or in true reflexes, as the focussing image is produced by the taking lens. The temporary screen can be of assistance here, too.

If your camera will not focus down to any distance less than say, five feet, you can still tackle close-ups nearer than this by using a supplementary lens fitted in front of the camera lens. Any fitment that will hold the supplementary concentric with the normal lens and resting squarely against the lens mount, will do. Actually, a very slight separation makes no difference. If the camera is set at infinity, the image will be in focus at a distance equal to the focal length of the supplementary. A cheap plano-convex spectacle lens will be found quite satisfactory,

as the camera lens will generally be "stopped down."

Stopping down to a small aperture is necessary to obtain the clearest detail and the greatest possible depth of field. Perhaps, that last part could do with some clarifying. In an ordinary snapshot taken outside, a landscape, perhaps, details in the scene will normally be sharp from infinity to within a few feet of the camera. If you at f. 11, a normal "snap" aperture. The nearness has resulted in obvious distortion, and the comparatively large aperture was quite incapable of rendering the far end sharp and clear at that range. That is, insufficient depth of field. Fig. 2 shows the same set up, taken from some three feet away, with the lens stopped down to f. 32, resulting in a great improvement all round.

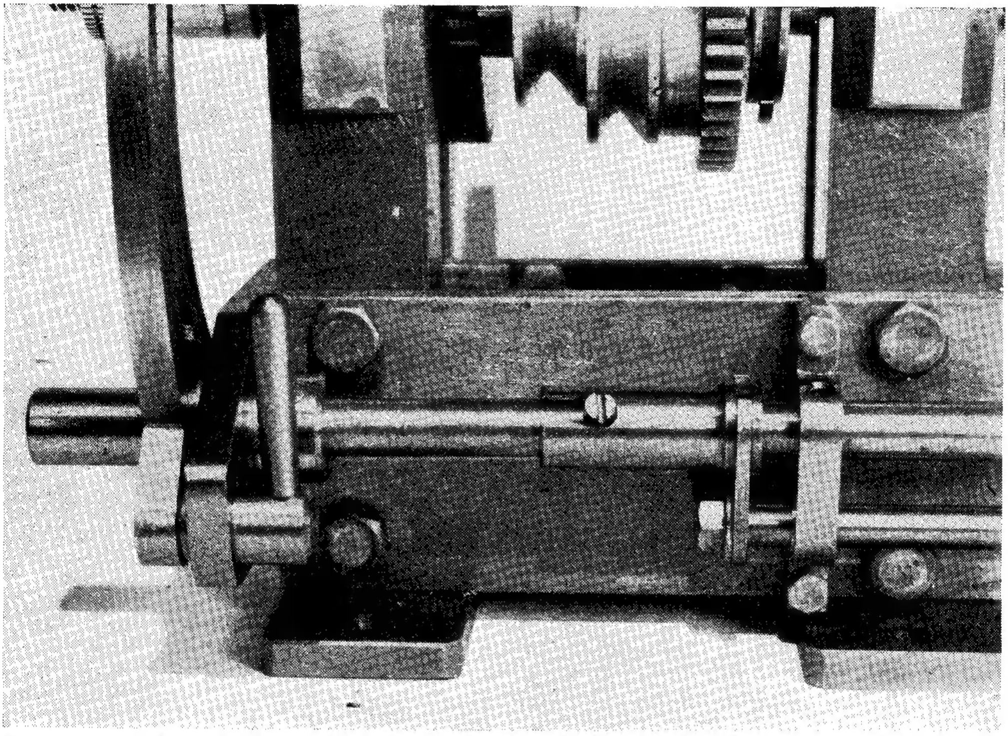


Fig. 3. Lathe self-act knock-out gear, showing extreme close-up possible with subject having little depth

now take a correctly focussed shot from about ten feet, of Fred getting up steam in his locomotive, anything further than a few feet behind him or nearer than a foot or two in front of him will get rapidly "fuzzier," the farther away it is from the point focussed on. The distance into the picture over which the scene is in acceptably sharp focus is the depth of field. Now, the closer you work to your subject, the smaller that depth becomes, so that if you take a close-up of the motion work on Fred's locomotive at two feet, your depth of field will be no more than an inch or two. That depth can be increased by stopping down, so it generally pays to stop down as far as possible.

The pair of pictures of the bar on the V-block shows this effect. They also show the effect of distorted perspective by overdoing the close-up, and getting TOO near. There is a happy medium about this, like everything else. Fig. 1 shows the result of two mistakes in the taking; it was taken much too close—about 20 in.—and

Subjects of this type are best taken by artificial light, and ordinary domestic pearl bulbs are quite suitable. Conical white cardboard reflectors are quite efficient for the occasional shot of this nature, and only one light, an ordinary 40 W pearl bulb about two feet away, was used for both shots of the V-block group. The same arrangement was used for the close-up shot of the lathe screwcutting knock-out gear, Fig. 3. This was taken at a range of about 15 in., but here the subject is all in the same plane, nearly enough, and there is no great depth to it. The extremely small depth of field was sufficient to accommodate such a shallow subject.

The writer has never found it necessary to use more than two lights, and two were used for the general view of the home-made lathe, Fig. 4. Where two lights are used, there is the risk of obtaining two sets of shadows, which looks most unnatural. Position the main light first, so that shadows do not confuse detail in the subject. The second lamp should be placed considerably

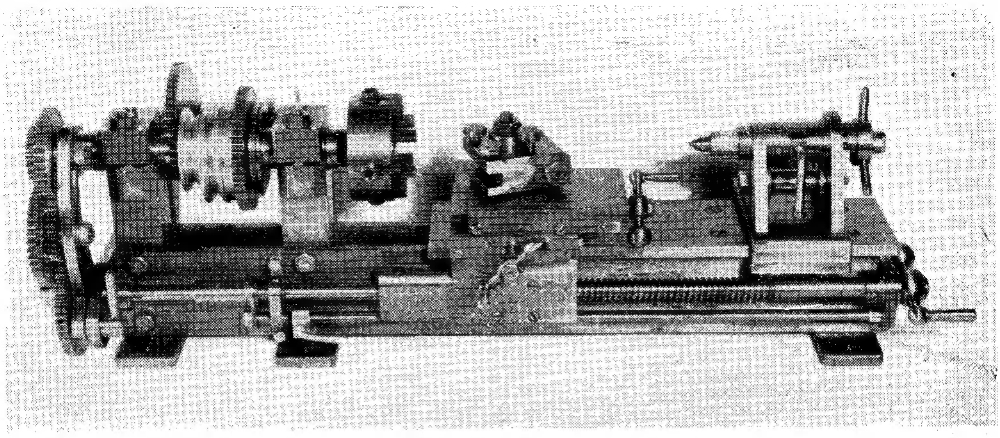


Fig. 4. General view of home-made lathe

farther away from the subject than the first, so that its light is much weaker than the main one. Its function is merely to lighten the dark areas and show up details which might otherwise be lost in shadow. The secondary light should always be diffused, as should the single lamp when only one is used.

Diffusing evens out the light and softens and reduces any harsh shadows. The simplest way to do this is to hang over the front of the lamp an old piece of muslin curtain.

Exposures will vary somewhat according to the subject and the lighting. On medium to high-speed panchromatic films or plates with one diffused light about two feet away from the subject, start off with a trial exposure of 70-90 secs. at f.32. Varying light distance and stop will call for adjusted exposure time, of course.

The subject of lighting and shadows brings in the question of backgrounds. All the subjects shown were taken on and against white card. This is much to be preferred to a white backing sheet, which wrinkles and sags. The tone in the picture of white or light grey card can be varied from white to almost black by the amount of light allowed to fall on it. The darker the subject, the lighter the background needs to be, and vice versa.

Bright steel can usually be taken against a light background, for, although it may be bright, the steel is not actually white in itself. Only the highlights will be clear white paper in the print. The lathe is made entirely from bright mild steel bar and rod in commercial sections, yet the photograph shows detail clearly enough against the white card. Just as a matter of interest, it is $1\frac{3}{4}$ in. centres, back-geared and screwcutting, and was built as an improvement on a very crude one made from scrap while in the Service. It was made for a friend who was very intrigued with the original.

If you intend photographing some machining set-ups, look back at some of the illustrations to Mr. Westbury's articles on machining engine components, and note how the job should be done.

When it comes to the final print, an enlargement of about whole-plate size ($8\frac{1}{2} \times 6\frac{1}{2}$ in.) is a convenient size for handing round on club nights, or for reproduction as an article illustration. Glossy prints will show detail much clearer than any other surface paper, and when pictures are intended for press reproduction, glossies are essential. Glazed glossies are even more acceptable, if you have the facilities.

So now, may your lenswork in future be as good as your lathework!

Fractional Horse-Power Motors

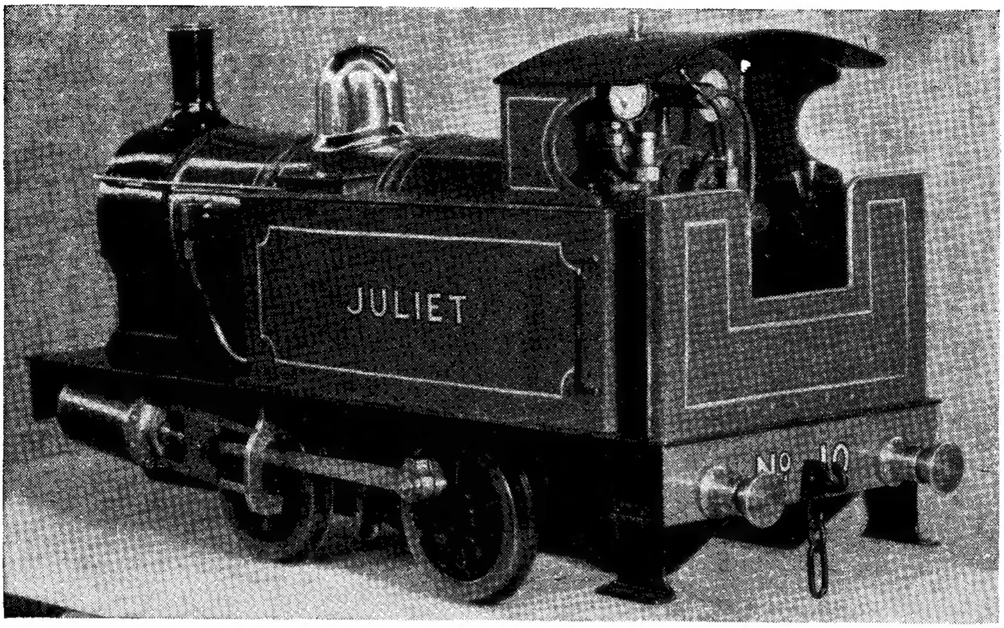
We have received recently from the Brush Electrical Engineering Co. Ltd., Birch Grove, Cardiff, S. Wales, details of their fractional horse-power motors (from 1/6 h.p.). These are of three types, solid foot mounting, resilient mounting and flange mounting, and are adaptable to the many odd jobs in the modeller's workshop which necessitate an auxiliary drive of some sort.

Manual or automatic resetting thermal overload cut-outs can be fitted to single-phase capacitor start and split-phase motors, in order to safeguard them against burning out during the overload. Thermal overload cut-outs enable motors to work to their maximum capacities, free from nuisance trips.

Shaft extensions are either $\frac{5}{8}$ in. or $\frac{1}{2}$ in. diameter by 2 in. long. Double shaft extensions can be supplied at $\frac{5}{8}$ in. diameter by 2 in. long.

All motors can be fitted with either sleeve or ball-bearings. It is recommended that where motors are being mounted other than in the horizontal position, ball-bearings are used. Bearings need lubricating about every 12 months, and for motors that are difficult to reach in service, extension oilers can be fitted.

Prices of split-phase and capacitor start motors, together with further information, may be obtained from the makers at the above address.



A FIRST ATTEMPT "JULIET"

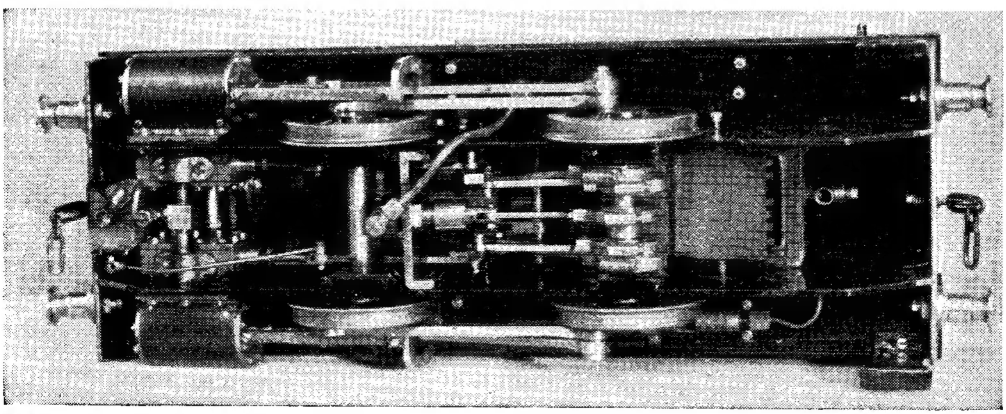
by H. Brown

THE photographs reproduced herewith are of my *Juliet* and I hope they will interest some beginners.

The engine in question is my very first attempt, although I am 63 years of age. I have been going to make one right from school days, but had no tools. I was a reader of the "M.E." when it cost 2d., or 4d., and what value? It still is, to all, let alone the beginners.

This engine came to my notice immediately I opened the issue of November 7th, 1946. I decided then and there that *Juliet* was to be THE engine after all the years that had passed, and it is now an actual fact. I can hardly believe it even now. All thanks are due to THE MODEL ENGINEER and that grand expert "L.B.S.C." He guided me through word by word, and, of course, the music.

I bought a few castings and made a few with the aid of a 5-pinter, and a home-constructed furnace. Nuts and bolts took hours to make, including studs, etc., but I did make it, apart from the material and steam gauge. I included the Stephenson reverse gear, as I always stated my engine must have a lever for reversing. It was completed in 3 years 10 months, spare time, of course. There is no need to give details, except the gross underestimated power of the engine. It will pull four men, not three; and the steaming is really unexpected, I really "was amazed."



Model Car Supplement

Simple Performance Calculations

by A. M. Colbridge

IN a serious attempt to analyse model car performance in terms of simple formulae we have had literally nothing to start with. The problem was, basically, to see if model car performance could be reduced to *simple* and *useful* calculations allying facts and figures—not a theoretical hypothesis of what may, or should, take place.

As a start we took the simplest formula which is used for full-scale car performance calculations, equating brake horse-power available against total resistance. In this case total resistance is compounded of two parts—rolling resistance which depends largely on the weight of the car and its various internal frictional resistances; and air resistance which depends on the speed and shape of the car.

Still talking of full-scale practice, the rolling resistance is considered to stop constant at all speeds and to be of the order of 40 to 80 lb. per ton laden weight. Air resistance obviously depends upon the degree of streamlining and is represented as a coefficient representing the "streamline efficiency" times the square of the speed. This coefficient takes into account both the shape and size (particularly the cross-section) of the vehicle. For the modern saloon car this coefficient may be as low as 0.015. For the ordinary open car 0.05. Corresponding figures for a motor-cycle are lower—0.015 for a semi-prone rider and about 0.02 for an upright rider. This is quite logical for the motor-cycle, although less streamlined in itself, has less sectional area. The complete formula then is :—

Total resistance $= Q + CV^2$

where Q = rolling resistance (lb.)

C = coefficient of streamlining

V = speed in m.p.h.

Now in the case of a model car on a tethered circuit, this formula still holds good, except that there is an additional resistance to motion—the drag of the cable. Since this cable is maintained above the height of the ground, this drag will be air drag only.

Now here we are rather fortunate. Speed control-line model aircraft operate on a similar principle—flying round on the end of a cable (in this case two thin wires)—and quite an amount of data has been collected and published on line drag at various speeds. These same figures we can apply to model car work. Our model car formula becomes :

Total resistance, $R = Q + CV^2$ + line drag.

Knowing the total resistance we can then relate this to horse-power required for any speed, or speed corresponding to any applied horse-power, by the formula :

$$B.H.P. = \frac{1.47\,V\,R}{550} \quad \text{where } V = \text{speed in m.p.h.}$$

Now both of these are simple working formulae which, if applicable to model cars, can be of some considerable interest, if not direct use. We have stressed "interest" rather than "use" for we feel that the solution for greater speeds is essentially a practical one—improved engine power and operating technique rather than improved shapes and sizes of car. Yet with such simple working formulae we can analyse the effects of possible changes in some of these design features and assess whether or not they would be worthwhile subjects for practical experiment and test.

The one part of the formula for total resistance

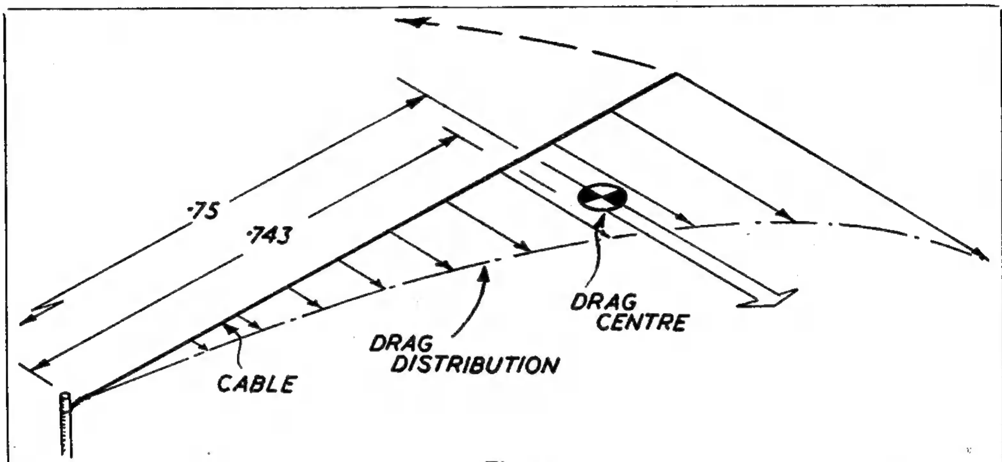


Fig. 1

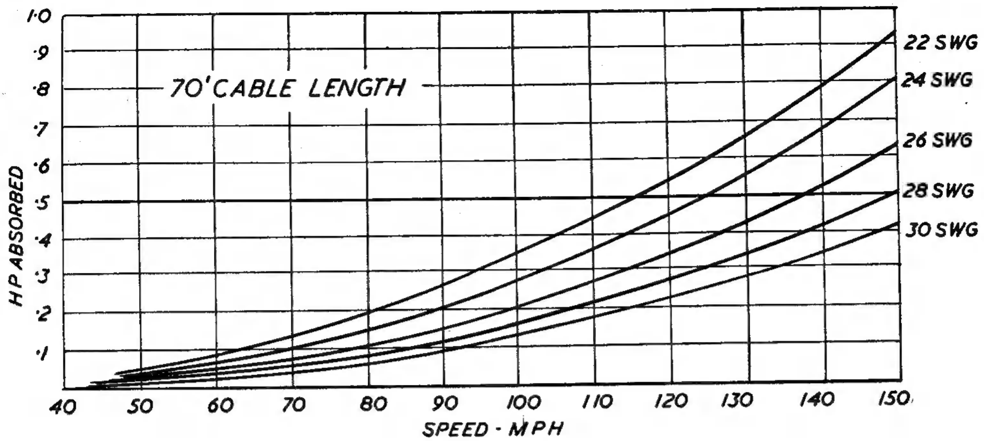


Fig. 2

which we should be able to work out fairly accurately, in view of the data already available, is line drag. If we tackle this first we can go on to the other factors afterwards.

Unfortunately, there is no simple solution to line drag. It cannot adequately be reduced to a coefficient (depending upon line size) times the square of the speed. This is because the actual coefficient changes very considerably itself with speed—not only with the speed of the model at the end of the line or cable, but along its own length at any speed!

Obviously the line or cable will itself have a different speed at each part of its length. At the centre it will have no speed—at the end the speed of the car attached to it—Fig. 1. Drag distribution will be proportioned similarly. Assuming that the drag coefficient of the cable does remain the same from centre to end, the actual drag centre of the line is then three quarters of the line or cable length from the centre. Correcting for the effects of the drag coefficient of the line or cable itself changing from centre to end, the true drag centre is more accurately 0.743 of the line length (according to F. E. Deudney in the September, 1950 issue of *Model Aircraft*). The actual difference, then, is not so very great.

The same writer has carried out numerous theoretical calculations of line drag, given in that same issue of *Model Aircraft* and also the October, 1950 issue of the same journal and rendered line drag in the form of horse-power absorbed by certain lengths of line at different speeds. As is to be expected, horse-power absorbed increases rapidly with increasing speeds, and also varies with line diameter. Unfortunately, these are not directly applicable, for they have been calculated for standard twin-wire model aircraft line lengths and model aircraft control line wire sizes. They have, however, been used as a basis for producing similar figures for model car practice.

Figs. 2, 3 and 4 reduce line resistance to terms of horse-power absorbed at various speeds for different diameter single cables. Figs. 2 and 3 correspond to 1/12th and 1/16th mile tracks,

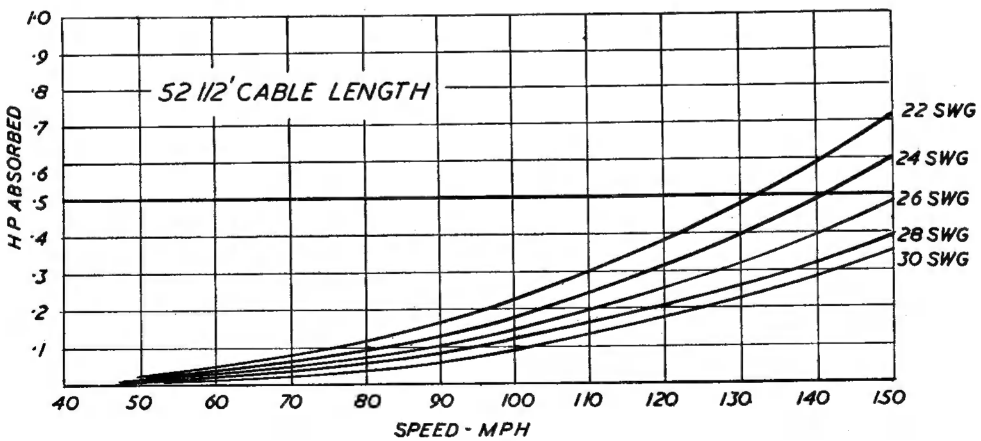


Fig. 3

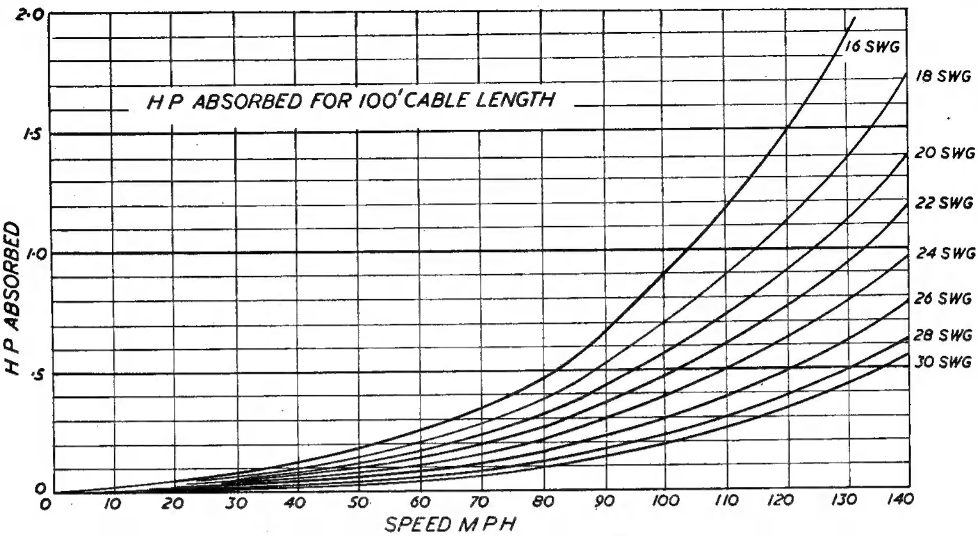


Fig. 4

respectively. Any other line length can be calculated by reading the corresponding drag for 100 ft. of line length from Fig. 4 and factoring accordingly. For example, 35 ft. line or cable length would have 35/100 times the drag of 100 ft. cable at the required speed. The diameters specified have been chosen to cover the range of sizes most likely to be used in all the competition classes.

Having reduced line drag to terms of horse-power absorbed, we can now modify our original formula to read :

$$\text{Total resistance} = Q + CV^2$$

This has reduced the "resistance" formula to the same as that for full-scale practice, or free resistance for model cars. This figure is almost bound to be higher than full-scale practice. The best full-size figure is about 1 lb. per 56 lb. car weight. Good model practice is likely to be twice this figure, or even higher. This works out at $\frac{1}{4}$ lb. or four ounces for a typical 7 lb. car. As with full-scale practice we will assume this to be constant at all speeds. We can only generalise in this manner if our performance calculations are to be kept simple.

Assuming this figure, then, we can do some check calculations on an established car's performance to find a representative value for C, the air resistance or streamline coefficient. This would appear to be in the order of 0.0002 for a

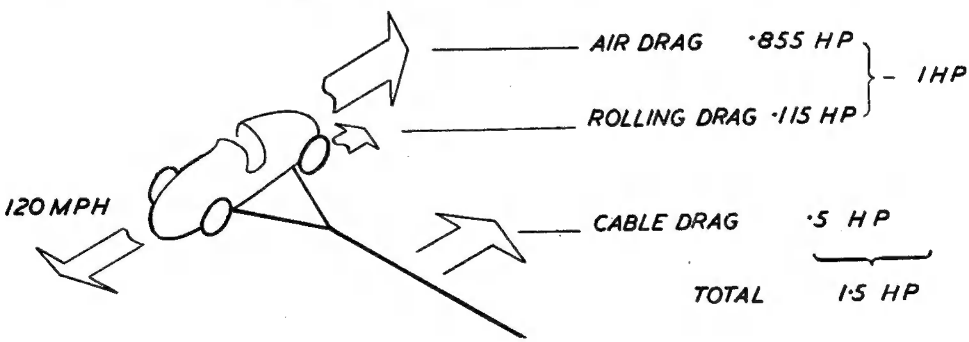


Fig. 5

running. The "power" formula, however, must be modified, for the power available is now not the brake horse-power of the engine, but this figure less the horse-power absorbed by the cable, viz. :

$$\text{B.H.P.} - \text{cable H.P. absorbed} = \frac{1.47\ V\ R}{550}$$

Now let us try to establish a figure for rolling typical prototype. This figure, it will be noticed, is much lower than full-size coefficients since the cross-sectional area involved is so much smaller. In a formula determining drag by multiplying the drag coefficient by the cross-sectional area and then by the square of the speed, the actual drag coefficient here would be larger in model sizes.

We [redacted] now check back our figures in the original formula by assuming [redacted] certain performance and seeing if our figures balance out. As [redacted] hypothetical example let us take [redacted] 7 lb. [redacted] with a 10 c.c. engine developing some 1.5 brake horse-power, the top speed of which has been found to be 120 m.p.h. on [redacted] 70 ft. cable. Such is [redacted] reasonable figure, if somewhat high by British standards. There is actually a reason for

Let [redacted] do another quick calculation for a typical car in the smaller class. This is powered by a Dooling "29" which is stated [redacted] developing 0.75 b.h.p. The car weight in this case we will take [redacted] 5 lb., when the rolling resistance will be 1/28th of this (in similar proportion to the larger car) or 0.179 lb. (say 0.18 lb.).

The streamline coefficient will be the same. Possibly it will be smaller overall, the decrease

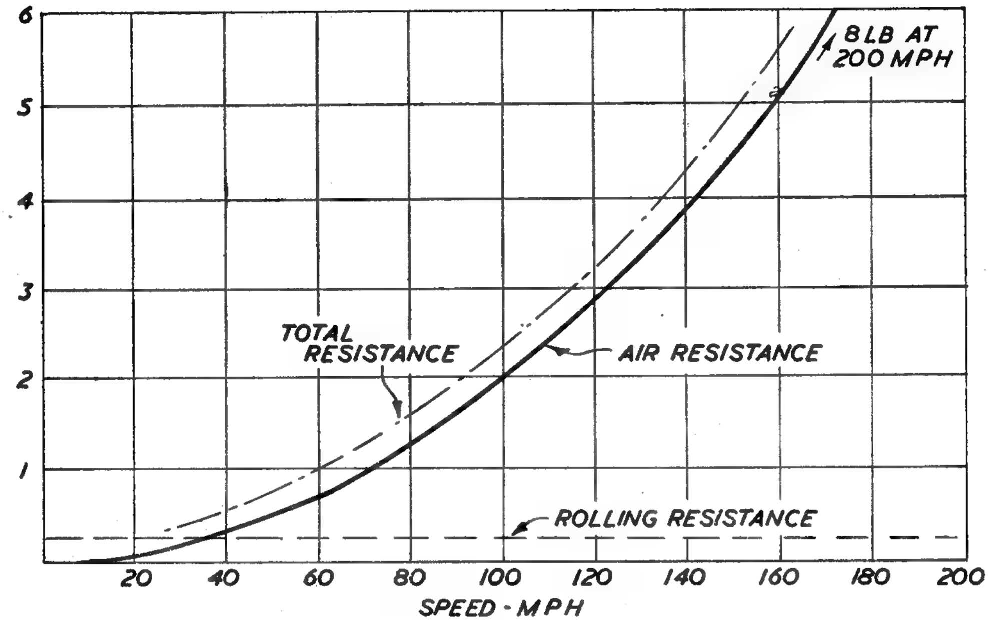


Fig. 6

taking a fairly high figure, which we will not go into. It also represents a good average between British and American figures.

Our total resistance is now made up as follows :

$$R = 0.25 + 0.0002 \times 120^2$$
$$= 0.25 + 2.88 \text{ lb.}$$
$$= 3.05 \text{ lb.}$$

The majority of resistance to motion, in this case, is air resistance. This, in fact, is a common feature of high speed operation. Above about 40 m.p.h. air resistance is definitely the predominant factor, and hence the importance of streamlining at this speed and above. We shall have more to say on this subject later.

Now from the horse-power formula, the power absorbed by the total resistance of 3.05 lb. at 120 m.p.h. is :

$$B.H.P. = \frac{1.47 \times 120 \times 3.05}{550}$$
$$= 0.98$$

Of the total horse-power available—nominally 1.5—part is absorbed by the resistance [redacted] above and part by the cable drag. A 24 s.w.g. cable at 120 m.p.h. and 70 ft. in length absorbs 0.45 horse-power, making [redacted] total of power required or 0.98 plus 0.45 [redacted] very nearly 1.5 b.h.p., and so these figures [redacted] satisfactory.

in cross-section more than compensating the higher aerodynamic drag coefficient of the smaller body at [redacted] lower speed, but to keep it simple we will assume that the overall coefficient remains the same.

$$R \text{ then} = 0.18 + 0.0002 \times 100^2$$
$$= 2.18 \text{ lb.}$$

At 100 m.p.h., which is [redacted] possible high speed for such [redacted] car :

$$H.P. = \frac{1.47 \times 2.18 \times 100}{550}$$
$$= 0.58$$

Line drag of [redacted] typical cable at this speed—52½ ft. cable length, diameter 26 s.w.g.—is equivalent to 0.15 b.h.p. absorbed. Thus the full power absorbed is :

$$0.58 + 0.15 = 0.73$$

which compares very well with the rated 0.75 b.h.p. of the motor in question.

It seems, therefore, that the figures adopted are acceptable ones and we can use them, and the formulae, to draw interesting comparisons [redacted] possible pointers to future development.

It is interesting, first of all, to see just how the brake horse-power available is used up. Taking the 120 m.p.h. car again as our example, one third of the total power is absorbed by the line

and two-thirds by the combined rolling and air resistance. Of the latter two, air resistance is nearly eight times greater than the rolling resistance, the complete values being shown in Fig. 5.

There are two ways of increasing the speed. Boost the brake horse-power available and a new balance of forces will be established at a higher speed. Unfortunately, however, both cable drag and air resistance increase as the square of the speed, and so a far increase in power may only result in a very moderate increase in actual speed. In the example quoted, boosting the b.h.p. to 2.0 would only result in the top speed being increased to about 147 m.p.h.—an increase in speed of just over 20 per cent. at the expense of a 33 per cent. increase in power.

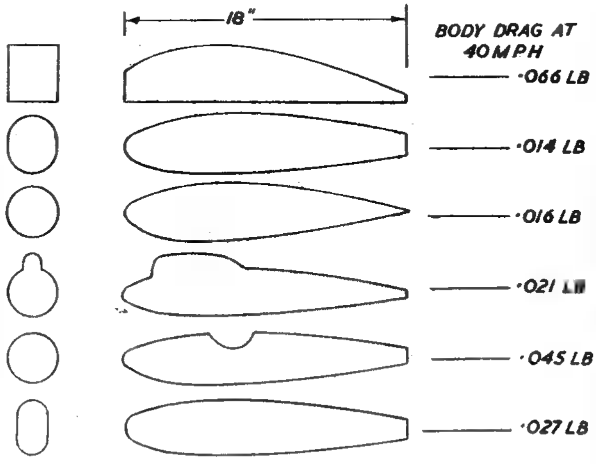


Fig. 7

That the cable drag contributes such a large percentage of the overall drag would seem a possible source of improvement. Thinner, shorter cables, for example, would reduce line drag accordingly, although not so much as might be expected at first sight. One must also not lose sight of the fact that there is a definite minimum size for cables, depending on the class and weight of the car, to meet official strength requirements.

Saving in drag by decreasing line diameter is relatively small, for the same line length. Decreasing line length, on the other hand, decreases

THRUST IN LB.* EQUIVALENT TO H.P. AT VARIOUS SPEEDS

Speed m.p.h.	HORSE POWER 0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	2.0
1	75	112.5	150	187.5	225	262.5	300	337.5	375	412.5	450	485.5	525	562.5	750
5	15	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90	97.5	105	112.5	150
10	7.5	11.25	15	18.75	22.5	26.25	30	33.75	37.5	41.25	45	48.6	52.5	56.25	75
15	5.0	7.5	10	12.5	15.0	17.5	20	22.5	25	27.5	30	32.5	35	37.5	50
20	3.75	5.6	7.5	9.4	11.25	13.2	15	16.9	18.8	20.5	22.5	24.3	26.4	28.0	37.5
25	3.0	4.5	6.0	7.5	9.0	10.5	12	13.5	15	16.5	18	19.2	21	22.5	30
30	2.5	3.75	5.0	6.25	7.5	8.75	10	11.25	12.5	13.7	15	16.2	17.5	18.7	25
35	2.1	3.2	4.3	5.4	6.4	7.5	8.6	9.6	10.7	11.8	12.8	13.9	15	16.0	21.4
40	1.9	2.8	3.75	4.7	5.6	6.6	7.5	8.4	9.4	10.3	11.2	12.2	13.3	14.0	18.75
45	1.6	2.5	3.3	4.2	5.0	5.8	6.6	7.5	8.3	9.15	10.0	10.8	11.6	12.5	16.6
50	1.5	2.25	3.0	3.75	4.5	5.25	6.0	6.75	7.5	8.25	9.0	9.75	10.5	11.25	15
60	1.25	1.9	2.5	3.1	3.75	4.4	5.0	5.6	6.3	6.9	7.5	8.1	8.8	9.4	12.5
70	1.1	1.6	2.1	2.7	3.2	3.75	4.3	4.8	5.4	5.9	6.4	7.0	7.5	8.0	10.7
80	0.94	1.4	1.9	2.3	2.8	3.3	3.75	4.2	4.7	5.15	5.6	6.1	6.7	7.0	9.4
90	0.84	1.25	1.6	2.1	2.5	2.9	3.3	3.75	4.2	4.6	5.0	5.4	5.8	6.2	8.4
100	0.75	1.1	1.5	1.9	2.25	2.6	3.0	3.4	3.75	4.1	4.5	4.9	5.2	5.6	7.5
110	0.68	1.0	1.36	1.7	2.0	2.4	2.7	3.05	3.4	3.7	4.1	4.4	4.75	5.1	6.8
120	0.625	0.93	1.25	1.5	1.8	2.2	2.5	2.8	3.1	3.4	3.75	4.05	4.35	4.7	6.25
130	0.58	0.86	1.15	1.4	1.7	2.0	2.25	2.6	2.9	3.2	3.5	3.7	4.0	4.3	5.8
140	0.54	0.8	1.1	1.3	1.6	1.9	2.15	2.4	2.7	2.9	3.2	3.5	3.7	4.0	5.35
150	0.50	0.75	1	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25	3.5	3.75	5.0

*Balancing total resistance.

line drag proportionately. Thus faster times should come on smaller tracks, but here again there are other factors to consider, not the least being the stability of the car on small tracks.

Possibly the greatest single improvement could be made with regard to reducing air resistance. Rolling resistance, forming a relatively small part of the total resistance and absorbing a correspondingly small amount of the total power available would appear relatively unimportant at high speeds. If we again take our typical 7 lb. car with a streamline coefficient of 0.0002 and a rolling resistance of ¼ lb. and calculate total resistance at various speeds, we find that at all speeds above about 40 m.p.h., air resistance is the greater of the two and becomes progressively greater as speed increases still more—Fig. 6. This holds true throughout all the classes. Above about 60 m.p.h. streamlining really begins to pay.

Here we are in the unfortunate position of not having any actual test figures on body drag to work to. Ideally, we would need wind tunnel tests on body drag at around 100 m.p.h. for various body shapes when we could really access the merits of different layouts. Unfortunately, the only wind tunnel data available of this nature is confined to aircraft shapes. There is, however, something to be learned from these. We have illustrated several typical figures in Fig. 7, which serve to illustrate, if nothing else, the adverse effects of cut-outs and similar disruptions of the main body lines.

The point now remains, how can we best use the simple performance formulae and the generalised figures without resort to further intricate analysis. Main application, it seems, would be to find the *potential* maximum speed for any new car, or check its operating efficiency using actual test speed figures.

The formulae can be rewritten in terms of speed equals, but then become rather more awkward to use. The simplest way is, undoubtedly, still to calculate cable drag as a separate item deducted from the brake horse-power available.

The relationship between total resistance and horse-power required for different speeds can be reduced to tabular form, for convenience. Taking an initial figure of two-thirds of the brake horse-power available used to overcome total resistance, a few trial and error selections from this table and the line drag graphs of Figs. 2, 3 and 4 will then give an answer without actual calculation. That the car may not achieve this speed figure on the track is quite another matter The original estimated brake horse-power may not be achieved by the engine ; or the car may not be running or tracking satisfactorily. A large proportion of the power may be wasted in wheel spin, for example.

Possibly one of the most interesting applications of the formulae are to take speed figures established by a certain model and work backwards to find the resistance figures of that model —or the probable figure for the power that engine is developing. This should also give more data for your own future designing, for with similar shape and layout your own resistance figures should be similar.

Finally, we amused ourselves by calculating the top speed of our original 7 lb. 120 m.p.h. example *without* the cable attached. The full brake-horse power available now balances out the running and air resistance at a new high speed :

$$1.5 = \frac{1.47\ V R}{550}$$

where $R = 0.25 + 0.0002\ V^2$

V—the new speed—now equals 138 m.p.h., certainly not as fast as one would "guesstimate" at first sight.

The Model Car Association

THE provisional constructional rules of the above association are as follows :—

(1) **Capacity Classes**

Cars shall be divided into classes by engine capacity, as follows :

Class 10. Cars propelled by internal combustion engines of cubic capacity exceeding 5 c.c. (0.305 cu. in.), but not exceeding 10 c.c. (0.610 cu. in.).

Class 5. Cars propelled by internal combustion engines of cubic capacity exceeding 2.5 c.c. (0.153 cu. in.), but not exceeding 5 c.c. (0.305 cu. in.).

Class 2½. Cars propelled by internal combustion engines of cubic capacity exceeding 1.5 c.c. (0.092 cu. in.), but not exceeding 2.5 c.c. (0.153 cu. in.).

Class 1½. Cars propelled by internal combustion engines of cubic capacity exceeding zero, but not exceeding 1.5 c.c. (0.092 cu. in.).

No tolerance shall be allowed for re-boring, etc.

(2) **Weight**

The weight of each car shall be taken when in running order, with fuel in tank, and shall include all parts carried by the car, except the tether if detachable.

The cars in each class shall not exceed the following weights :

Class 10 = 7½ lb.
„ 5 = 6 „
„ 2½ = 4 „
„ 1½ = 3 „

(3) **Wheels**

(*a*) Not less than four road wheels shall be fitted.
(*b*) Wheels on the same axle shall be of similar diameter and type.
(*c*) If different sized wheels are used on front and rear axles, the smaller wheels shall not be less than ¾ of the diameter of the larger wheels when at rest.

(4) Layout of Wheels

(*a*) The wheels shall be arranged in an approximately rectangular pattern in plan view.
(*b*) If the track of the front and rear wheels is not the same, the narrower track shall not be less than 9/10 of the wider track.
(*c*) The wider track shall not be less than $1\frac{1}{4}$ times the diameter of the larger wheels.
(*d*) The wheelbase of the car shall not be less than $2\frac{1}{2}$ times the diameter of the larger wheels.

(5) Drive

The drive must be applied by a direct mechanical connection between power unit and road wheel or wheels, when the car is in motion.

(6) Exhaust

The exhaust outlet, or outlets, must be so arranged as to prevent discharge directly on to the track.

(7) Body

All cars must be equipped with, and race in competition with, a body which complies with the following :

When the car is viewed centrally from axle level in side, front and rear views, the engine, gears, etc., shall be generally within the limits of the body, and not visible. Spark plugs, glow plugs and exhaust pipes will be permitted to protrude within reason, subject to the decision of the scrutineer.

The only major exception to this rule is in the case of a scale model of a definite prototype, such as a " Shelsley Special," in which case the entrant must produce a clear photograph of the original car for comparison.

(8) Tether or Bridle

All cars must be provided with a tethering attachment attached to the car in such a manner as will be capable of withstanding the following loads :

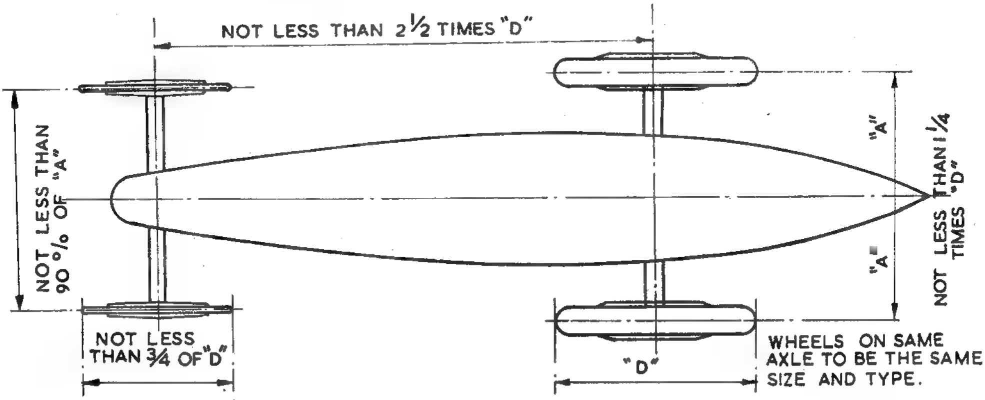
Class 10. 65 lb. per lb. of car weight. (Equivalent to 130 m.p.h. on a $52\frac{1}{2}$ ft. diameter track, with safety factor of 1.5).

Class 5. 46 lb. per lb of car weight. (Equivalent to 110 m.p.h. on a $52\frac{1}{2}$ ft. diameter track, with safety factor of 1.5).

Class $2\frac{1}{2}$. 28 lb. per lb. of car weight. (Equivalent to 85 m.p.h. on a $52\frac{1}{2}$ ft. diameter track, with safety factor of 1.5).

Class $1\frac{1}{2}$. 21 lb. per lb. of car weight. (Equivalent to 60 m.p.h. on a 35 ft. diameter track, with safety factor of 1.5).

Th length of the tether shall be not less than 9 in. and not greater than 10 in. from its apex or connecting hole to a line drawn centrally between the wheels of the car in the plan view.



Proposed minimum dimensions of cars, related to static diameter of driving wheels

(9) Stopping Device

All cars must be equipped with a device capable of stopping the engine whilst the car is in motion, either by switching off the ignition or fuel supply, or both.

(10) Running

(*a*) All cars shall be designed to run on all four wheels as far as is possible, i.e. : intentional positioning of tether so as to make the outer or inner wheels ride clear of the track shall be barred.
(*b*) All parts shall be securely fastened when running and any car dropping any part whilst running shall be disqualified from that run, unless timing has been completed.

(11) Compliance with Rules

All cars shall be inspected for compliance with these rules before racing and shall be run in the same condition as when scrutinised. Replacement of any part which fails shall be permitted at the discretion of the scrutineer, provided that the car still complies with the rules. Subject to compliance with rules, tyres, glow and sparking plugs, batteries, etc., may be changed without permission.

Tales of a Tyro

Size and Scale—by Edward Adams

IN THE MODEL ENGINEER for January 15th, 1948, there is an article by "L.B.S.C." entitled "The Biggest 2½-in. Gauge Locomotive Yet," which refers to a version of a Union-Pacific 4-8-8-4, the last but one to date of my making. (See photo below.)

Now, size is not in itself a virtue, I know; moreover, it is only a relative term. Witness the remark of a watchmaker friend on examining a 2½-in. gauge injector—a smallish thing to me. "I wish," said he, "I had the time to do such big work!"

But I am digressing from the 4-8-8-4.

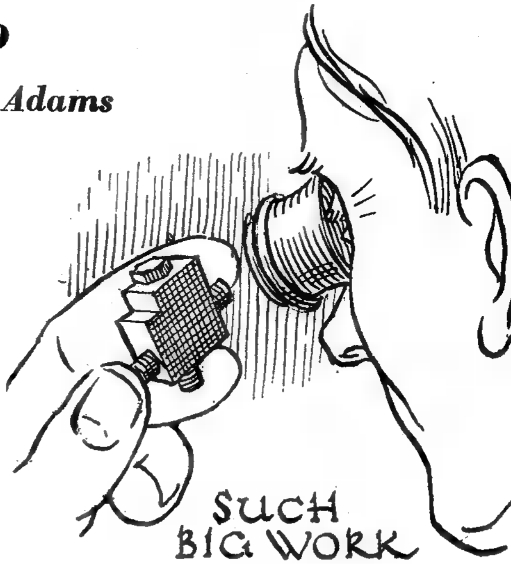
In the early days of the last war, before "L.B.S.C." discovered that he would soon be living in "bomb alley," I paid him a short visit; long enough, however, to borrow from him the *Locomotive Cyclopedia*.

The uninitiated should know that this is a book about American locomotives of exhaustive—almost exhausting—proportions, dealing also with all construction details in drawings and photographs, thousands of them, having over 1,200 pages and weighing about 8 lb.; an entrancing book for all lovers of the modern steam locomotive.

I was so delighted with the discovery of this weighty tome and the loan of it, that the long walk across London with the book, first under one arm and then the other, seemed almost effortless.

Many times I stopped in the street to dip into it, and the four-hour journey to the North passed in a flash.

Well, this book (of which I subsequently bought a copy for 30s., and never have I spent money to better advantage) confirmed me in my admiration for the giant American locomotives and was extremely useful in making the U.P. 4-8-8-4; in short, I was thoroughly bitten by the bug of bigness.



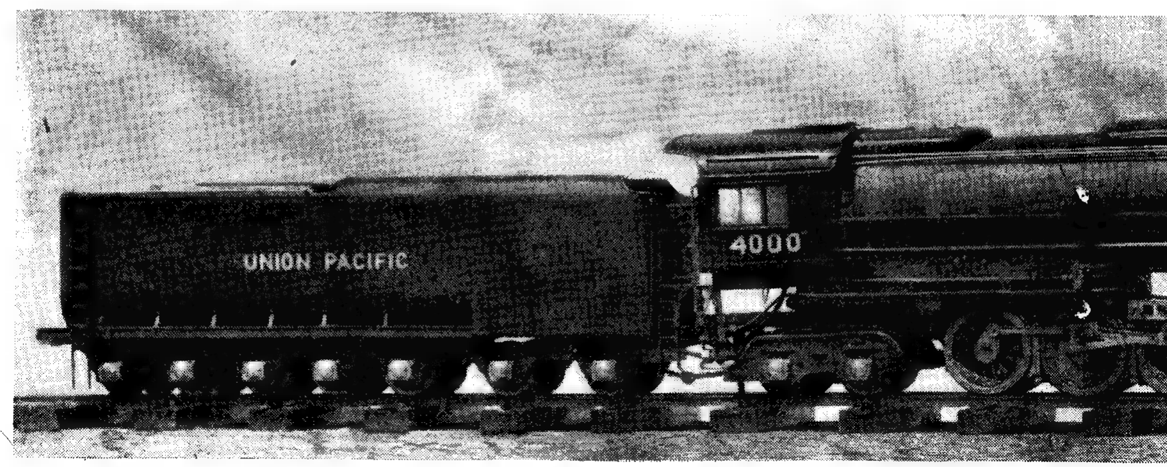
But it also raised the old question which recurs with every engine I have so far built; what detail to include and what to leave out.

It seemed to me that in order to capture the apparent size of the original I should have to pay close attention to scale, as a single screw-head, or an outsize component, will destroy the sense of realism.

Architectural models offer a parallel. The trained eye can at once detect a minute fraction of an inch, less or more than it should be, in a cornice projection or other feature, and the sense of looking at the real thing is lost.

Of course, such a model may still be of great value in displaying mass and proportion and giving a general impression of the structure.

The next questions to raise their hoary heads were: Can I make the part or component? If so, will it be large enough to work dependably? Failing that, should it be made for the sake of



appearance only, or some compromise of all, even omitted altogether?

How one would like to reproduce in small, a rocking grate, an automatic stoker and many other fascinating mechanisms on a $2\frac{1}{2}$-in. gauger, but experience at once asks how could they function in such a small scale without constant attention, even if they could be made to work at all.

One way out of this dilemma is to use the correct size and shape of a component to conceal a different purpose, as in the use of side tanks to house dry batteries for headlamps, which the purist would look upon as dishonest.

Perhaps the right approach is to decide what one expects of a small locomotive. Is it maximum performance and hard work on the track, with a minimum of fiddling adjustment, with easy accessibility?

Or it may be fairly accurate detail—functional and dummy—with a moderate performance.

Again it may be an entirely faithful reproduction to scale as to externals and with little or no performance.

Or combinations of these.

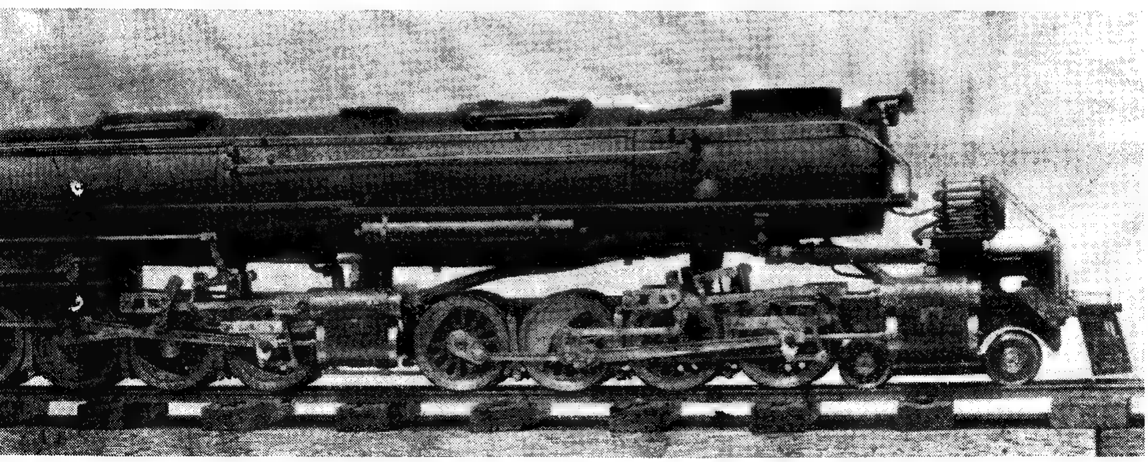
Modellers may well be in two or more camps on this issue, and it seems to me each must decide for himself. These problems become of less importance as the scale increases. A 5-in. gauge locomotive, for instance, can be much more realistic in working detail than a $2\frac{1}{2}$-in. gauge, and less so in the smaller scales.

So to return to the Union-Pacific. I followed my own example in what I have often done before; made it work first as a small locomotive, adjusted the design here and there for get-at-ability, accepted small detail capable of working, added some unworkable detail for the sake of realism, left off some.

But I wish I could have made the compensated springing!

In this I am of a mind with my friend N., who has a fine workshop of tools, including a 5-in. lathe, and uncommon ability to use them. With his friends he has the perhaps unenviable reputation for mending things.

Being asked to repair a wrist-watch he said, "No thanks. Tell your mother making suspension bridges is more in my line!"



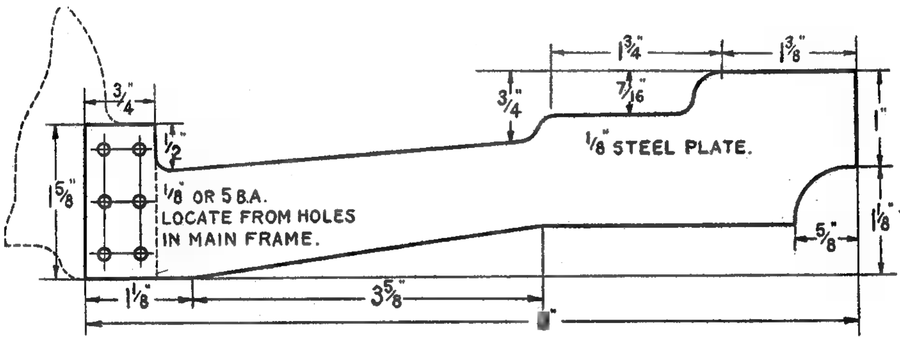
"Britannia" in $3\frac{1}{2}$-in. Gauge

by "L.B.S.C."

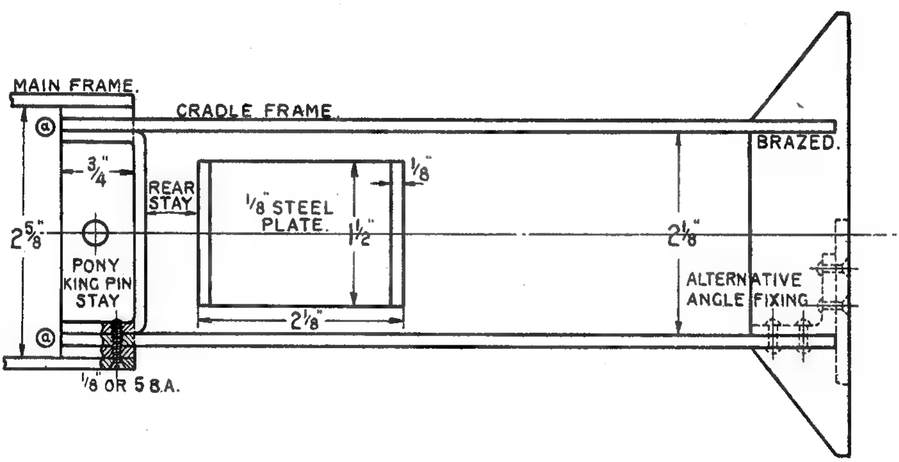
ON my own engine, the complete cradle, or trailing frame assembly, was built up from $\frac{1}{8}$-in. steel plate, stays and all, plus a 1 in. × $\frac{1}{8}$ in. angle drag-beam, as ■ single unit, and then attached to the main frames by six $\frac{1}{8}$-in. screws at each side. This has made ■ fine strong job, and here is the way to do likewise. First of all, no detailing is needed. All dimensions necessary, are shown in the illustration.

Buffer- and Drag-Beams

Make both beams whilst on the job, from 1 in. × $\frac{1}{8}$ in. steel angle, either bright or black ; I used the latter, having a piece in stock. I



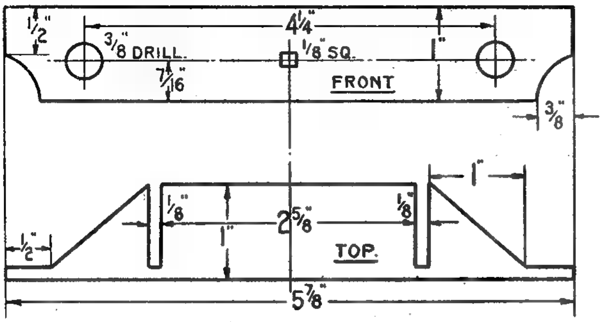
Firebox cradle or trailing frame



Plan of trailing frame

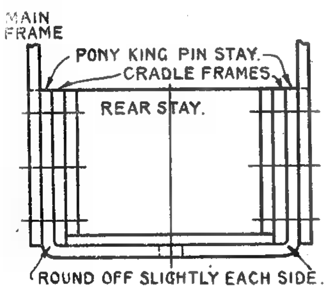
cut out the two side plates from $\frac{1}{8}$-in. mild steel ; this needs to be nice and flat and I think our approved advertisers will do the needful. It may be either bright or blue, but should be soft and ductile. I have found that some of the hard-rolled varieties alter in shape after ■ brazing operation ; and in days gone by, I once had the frames of an 0-6-0 take on a permanent curve, ■ though the engine had been consistently running around ■ circle, and had tried to adjust itself to the curve of the road. Cutting out the plates in ■ simple straightforward job, for which usually square mine off to dead length, by dropping a short piece of square bar in the angle, and gripping the lot in the four-jaw ; but on the majority of small home-workshop lathes, the overhang would be too great, so if you haven't any other means of machining, it is a case of falling back on the humble but necessary file. In the front of the buffer beam, drill two $\frac{3}{8}$-in. holes for the buffer shanks, at $4\frac{1}{4}$ in. centres, and note they are $\frac{1}{16}$ in. below the centre line of the beam, as is also the hole for the drawbar shank. Saw off the bottom corners, and file them out to

the curve shown. Cut the two slots for frames in the top of the beam, before sawing and filing to shape. If you have the use of, or own a milling machine, this can be done with a $\frac{1}{8}$-in. cutter on the arbor, holding the beam in the machine-vice; but if the lathe is your only machine-tool, you can do the job on it by mounting a $\frac{1}{8}$-in. saw-type cutter on a stout spindle between centres, and



Buffer beam

mounting the beam in a machine-vice on the lathe saddle. I described and illustrated a makeshift but serviceable machine-vice some time ago. Run at slow speed, and use plenty of cutting oil. If no method of machining is available, cut the slots by saw and file, as described for *Tich*, using the tops of the vice jaws as a guide to get the slots straight, and at right-angles to the beam, also at correct distance apart. The metal between the slots and the ends of the beam, is then sawn and filed away, as shown in the illustrations.



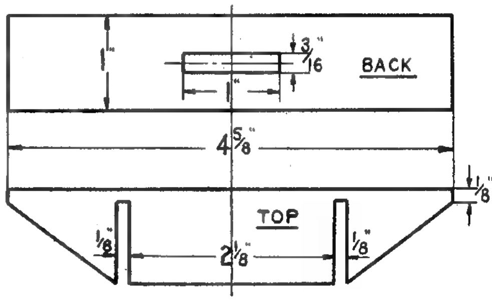
End view of trailing frame at (a) (a) in plan

The drag-beam is made in similar manner, but is a wee bit simpler, having all the top part, between frame slots and ends, filed off at an angle, as shown, right to the ends. A slot 1 in. long and $\frac{3}{16}$ in. wide, is cut in the face for the drawbar between engine and tender by the usual method of drilling a few holes and filing them into a slot. I cut mine on the vertical miller with a $\frac{3}{16}$-in. slot drill (home made) in the chuck, traversing the beam under the cutter by moving the top-slide or table; the ends were squared with a file. Incidentally, this is the shortest drag-beam I have ever specified for a $3\frac{1}{2}$-in. gauge engine.

Rear Stays

On my own engine I have put in a spot of "fabrication" at the front end of the cradle. The two sides are joined by a simple stay, of channel shape, bent up from a length of $1\frac{1}{2}$ in. $\times$ $\frac{1}{8}$-in. steel-plate. I just marked it out, put it in the Diacro bending brake with the marked line "spot on" to the edge of the forming bar, pulled up what Bert Smiff calls the "'arry-randalls," and there we were—dead to $2\frac{1}{8}$ in. width, with the two sides perfectly parallel. The piece could be bent in the bench-vice by first bending one side, then carefully marking out the place to bend the second side, making $\frac{1}{8}$ in. allowance for thickness of metal. I used to do it that way, before I had the machine, and always found it advisable to make the first bend, and then mark out the second from it. I don't suppose anybody would have a piece of bar of the odd size of $1\frac{7}{8}$in., but if they had, it could be put between the sides of the piece of channel, and the sides hammered down on it. Two pieces put together would do; for example, a piece of 1 in. and a piece of $\frac{7}{8}$ in. which are commercial sizes. If anybody were lucky enough to acquire a piece of $2\frac{1}{8}$ in. $\times$ $\frac{1}{8}$ in. channel iron or steel, all they would have to do, would be to cut it to $1\frac{1}{2}$ in. length, and trim the sides, if needed, to $\frac{3}{4}$ in. length, measured inside; see plan view.

The main frames being $2\frac{5}{8}$ in. apart, and the overall width of the cradle being $2\frac{3}{8}$ in., it is obvious that a $\frac{1}{8}$-in. distance-piece is needed at each side. I combined these, on my own engine, with the support for the king-pin of the pony truck, by bending up a strip of $\frac{1}{8}$-in. steel, $\frac{3}{4}$ in.



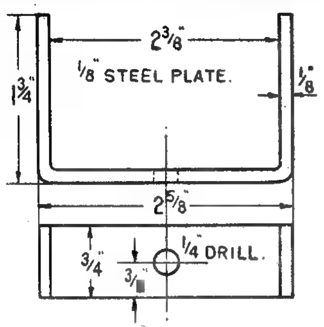
Drag beam

wide, as shown in the drawing. This being $2\frac{5}{8}$ in. wide outside, and $2\frac{3}{8}$ in. inside, it will be seen that if the main frames go outside it, and the cradle frames inside, we not only settle the distance-piece requirement, but our pony king-pin gets a substantial support in addition. Both the plan view, and the end view of the arrangement of stays at the back end of the main frame, should make this quite clear.

How to Assemble the Cradle

It is absolutely essential that both sides of the cradle frame are dead parallel in every way, and square with the drag beam and the stay at the

front end. I set mine up as follows. As I cut the slots in the drag-beam on my horizontal miller, I knew there was no question about them being dead square with the beam. They were also of the right width, so that the frame plates jammed in tightly. Therefore, when I squeezed the frame plates right home in the slots, they couldn't help being parallel as far as width was concerned. To get the top and bottom of each frame O.K. I put a pair of parallel bars (not the kind found in the gymnasium !) on the



Pony king-pin stay

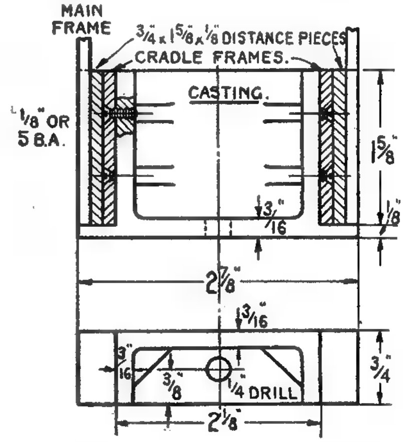
table of the drilling machine, and set the frames on them, adjusting so that there was no vestige of a rock. Next, the channel stay was put between the open ends of the frames, then the pony stay outside, the frames being held between the two. Application of a try-square, soon set both these in correct relation to the frame plates, and a couple of toolmaker's cramps, judiciously applied, made certain that they didn't depart from the paths of virtue. The box in which I keep odds and ends of steel bar for packing and so on, yielded two bits of 1 in., about 4 in. long, and a piece of 1/8-in. strip ; these, placed together, made up the 2 1/8 in. needed to fit between the frames. In they went, and a good hefty G-clamp—which once belonged to Bro. Wholesale of blessed memory—was placed over the outside of the frames, and well tightened up. As the whole issue still stood on the parallels without a rock, it was obvious that they were now lined up correctly.

Two No. 41 holes were drilled clean through the sides of the pony stay, the frames, and the channel stay, at each side, and two 3/32-in. iron rivets put in. The clamps over the stays were then removed, and the assembly tested on the parallels again, and found to be dead true, so it was promptly transferred to the brazing pan. Some wet Sifbronze flux was applied to the frames where they entered the drag-beam slots, and also to the three thicknesses of 1/8-in. plate, formed by the two stay flanges and cradle frame, at the front end. A few minutes with my oxy-acetylene blowpipe, and a 1/8-in. Sifbronze rod of No. 1 grade, was sufficient to form a fillet of Sifbronze between the ends of frames, and both angles of the drag beam ; the flame was then applied to the front end, and the stay flanges and ends of cradle frame, welded up solid. A 150-litre tip in the blowpipe, heated the actual joints sufficiently to make the Sifbronze run as freely as water, yet the metal, an inch or so away, was hardly discoloured. The frames couldn't shift, because of the big cramp ; and when I released it, and took out the packing, the frames were O.K. for parallelism, and I realised that I must have an uncle named Robert. All that remained, was to knock off the burnt flux with a file that had worn too much to be of use for its legitimate purpose, and we were—literally—all set.

I don't imagine for one moment, that there are many home workshops owning an oxy-acetylene outfit—the "putting-on tool" of the famous workshop joke, actually come into being ; there's many a true word spoken in jest !—but that needn't worry any builder of *Britannia* in the slightest. As long as the assembly is set up truly, it can be brazed in the ordinary way with a blowlamp. The way I clamped mine, as described above, is rigid enough to keep the lot in proper alignment whilst the whole of the drag beam, and the rear ends of the frames, for an inch or so along, are blown up to bright red, hot enough to melt ordinary easy-running brazing strip. Soft brass wire can also be used for brazing material, with Boron compo, mixed to a paste with water, as flux. If the front ends of the cradle frames, and the stay flanges, are well fluxed, the brazing material will run clean through, and the job won't be one whit inferior to my own.

Alternative Methods

I mentioned in the introductory note, that castings could be used, if desired, in place of built-up or fabricated parts, and alternative



Alternative cast king-pin stay

methods of construction can also be used by those who prefer them. The way that the leading end of the cradle frame could be made up with a casting, is shown in the accompanying illustration. The casting is like a channel, with strengthening ribs, mounted end up on a flat baseplate ; but, of course, all cast in one piece. The bottom of the base would have to be machined off, either in a four-jaw chuck, or on an angleplate on the face-plate, or it could be milled or planed, or even filed up truly. Both sides of the casting would

(*Continued on page* 360)

THE AUTO-TRANSFORMER

by J. W. Cooper

THERE appears to be very little information [redacted] to the subject of auto-transformers outside the standard text-books on transformer design. The auto-transformer is not [redacted] special or complicated piece of apparatus, it is simply an ordinary transformer connected in [redacted] different manner.

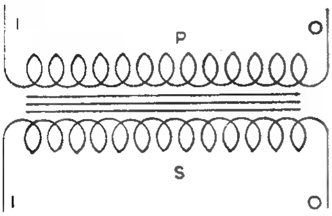


Fig. 1. *Arrangement of ordinary transformer*

The auto-transformer is not necessarily limited in its application, but it seems to confine itself to particular applications.

From [redacted] constructional point of view the auto-transformer is cheaper to build and there are no snags in its make-up. With the ordinary transformer we have [redacted] iron core and an arrangement of coils on this core ; these coils are assembled in several different ways to meet design requirements. In one case there are just two coils, the primary and secondary ; these two coils may be assembled side by side on one limb of the iron system, on the other hand these coils may be assembled one on each limb. In another direction there may be several secondaries ; when this occurs, the respective coils may all be wound on one limb or they may be wound on separate limbs. Sometimes these coils are wound as sections and distributed over the iron system in accordance with the required design.

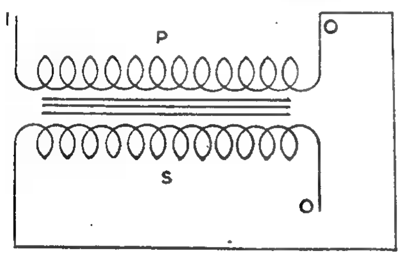


Fig. 2. *Ordinary transformer connected as* [redacted] *auto*

As just stated, the ordinary transformer has [redacted] separate primary and secondary winding, usually arranged as shown in Fig. 1. This arrangement of coils can be converted into the auto connection by simply connecting the primary and secondary in series ; this is shown in Fig. 2. If we now rearrange the coils of our transformer on one limb of the core, the rearrangement will be as in Fig. 3. Connecting [redacted] in Fig. 4, we again have the auto connection ; extending this diagram we have the arrangement Fig. 5.

In the arrangement of the respective primary and secondary windings, it should be noted that the secondary end should always be connected

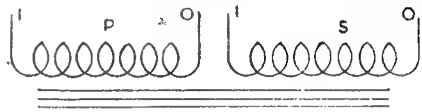


Fig. 3. *Ordinary transfromer with primary and secondary assembled on one limb*

to the supply on the earthed or neutral side. If the transformer is connected in this manner, the pressure across the secondary terminals to earth will never be higher above earth than the secondary voltage. Fig. 6 shows what is meant by this connection.

In the auto-transformer, and [redacted] the respective primary and secondary are combined, the secondary becomes [redacted] percentage of the primary winding ; that is, the primary turns. Suppose, for example, an ordinary transformer to have 100 primary turns and [redacted] secondary of 10 turns—the combined

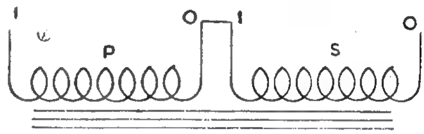


Fig. 4. *Transformer connected as in Fig.* 2

turns will be 110. With the auto-transformer there will be a total of 100 turns only because the secondary is [redacted] percentage of these 100 turns, in this case 10 turns. It will be seen, therefore, that the secondary copper of the ordinary transformer is saved, as a separate secondary is not required. Also, it is seen that the calculation is for [redacted] primary winding only, allowing what percentage of turns that may be necessary for the secondary. In the case outlined it will be seen that in this winding [redacted] tap is brought at 10 turns from the commencement of the winding.

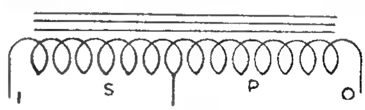


Fig. 5. *Combined primary and secondary as one winding*

As tappings may ba taken at any point along the winding the auto-transformer is, in [redacted] way, not unlike [redacted] potentiometer. If necessary, it would be possible to take taps at each turn and by so doing obtain [redacted] very fine adjustment of voltage over [redacted] range.

A point that must always be borne in mind

when working out [redacted] winding for [redacted] auto, is that the secondary has also to carry the current demanded by the primary. This being the case, the wire should be adjusted so as to allow for this current over the amount the secondary will be called upon to deliver at full load.

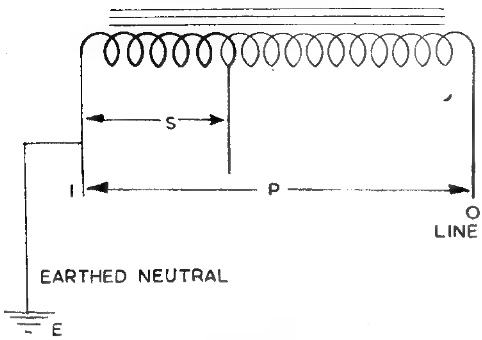


Fig. 6. Auto transformer connections to source of supply

As mentioned earlier, the auto-transformer is not limited in its application, but it appears to confine itself to certain uses only. In the earlier days of lighting and when metal filament lamps could not be worked at voltages above 25-50, the auto-transformer was [redacted] cheap and convenient way of obtaining this reduction of voltage. The auto-transformer today finds [redacted] useful application for some types of welding transformers; also, it is extensively used in a form of electric motor starter, the auto-transformer starter. This starter is used with a.c. motors and is [redacted] convenient way of obtaining the necessary voltage reductions required at starting. These transformers are usually provided with several tappings to enable suitable starting voltages to be applied to the motor.

As applied to radio, the auto-transformer has a rather limited use; it cannot be wound and used as the typical transformer for this purpose. The auto-transformer can be conveniently used to take the place of any set using the line cord method of voltage dropping and also with some sets that are a.c. operated, but working with [redacted] voltage dropping resistance instead of the normal transformer. For this purpose [redacted] suitable core section would be $\frac{3}{4}$ in. $\times$ $\frac{3}{4}$ in. and wound to the value of 10 turns per volt.

In conclusion, it is stressed that the auto-transformer is [redacted] safe piece of apparatus to use, but only so if attention is given to its method of connection to the supply. In any case, and [redacted] with any form of electrical apparatus where the wiring is accessible to the naked hands, the supply should always be turned off before attempting any adjustment or connecting.

"L.B.S.C."

(*Continued from page* 358)

need machining off to an overall width of $2\frac{1}{8}$ in., [redacted] shown in the plan view, leaving a ledge at the bottom, at each side, $\frac{3}{8}$ in. wide and $\frac{1}{8}$ in. thick.

To attach the cradle frames to this, it will first be necessary to fix the drag beam; and this may either be brazed to the frames, as described above, or attached with pieces of angle, as I have repeatedly described when dealing with frame erection on other engines. This variation is shown in the plan view of the complete assembly, by dotted lines. It is shown completely riveted, and there will be no need ever to take the frames apart again; but those who prefer the usual method of riveting the pieces of angle to the beam, and screwing the frames to the angles, can do it that way with pleasure.

The frames being true and parallel, the machined casting can be placed between the front ends, set true with a try square, and attached to the frames by four $\frac{1}{8}$-in. countersunk screws at each side, running through clearing holes in the frame, into tapped holes in the casting. These screws should be placed in between the screw-holes shown in the elevation drawing, [redacted] the latter [redacted] intended for the screws holding the main frames to the cradle frames. The bottom of the casting should have a $\frac{1}{4}$-in. hole drilled in it, for the end of the pony king-pin. When the main frames are attached, [redacted] distance-piece will be needed at each side of the cradle frame, to make up the correct width; [redacted] piece of $\frac{1}{8}$-in. steel, $1\frac{5}{8}$ in. long, and $\frac{3}{4}$ in. wide, will do the trick just right. If all goes well, I will describe the setting-up and erection of the main frames, and attachment to cradle frames, in the next instalment, also the bogie bolster and the main frame staying.

Unsolicited Testimonial!

A short while ago I received a letter from [redacted] Cambridge reader that was rather unique, and certainly very gratifying; it is worth recording, [redacted] an example, of how a little reasoning and adaptation can solve [redacted] problem. Our worthy friend built a small traction engine, only a weeny thing with [redacted] 2-in. boiler barrel, and only four $\frac{5}{16}$-in. tubes. He followed my ideas [redacted] to motion work, and the engine was all that could be desired, on air pressure; but as [redacted] steamer she was [redacted] complete flop. The fire wouldn't burn at all, so he fitted [redacted] spirit lamp, and managed to get it to run, though it "went sick" immediately the pump started feeding.

Then he read my note on how to make injectors lift, and the grey matter stirred. Why not try [redacted] similar "suction effect" on the little engine? No sooner thought of, than put into action; he got busy right away, made [redacted] blast nozzle like the injector steam cone, and [redacted] chimney choke like the lifting end of the combining cone, but of course, larger in proportion, to suit the job. Out came the spirit lamp, in went the grate and ashpan; steam was raised, and, lo-and-behold, the little engine was soon chugging merrily along with the pump full on, and blowing off skyhigh. Another example of what can be done with a little "know-how" properly applied!

Novices' Corner

Register-Pins

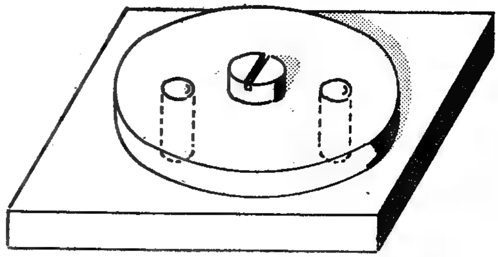


Fig. 1. Two components located with register-pins

WHERE machine parts have to be accurately located with reference to one another, the ordinary screws used for assembly cannot always be relied on to give exact positioning, and in this respect screws with countersunk heads are usually the least dependable.

Reasonable accuracy, sufficient for most purposes, can be obtained by using cheese-headed screws made to fine limits and engaging in holes reamed exactly to size. However, it is usually much simpler to employ the screws solely for fixing the parts together and to fit register-pins or dowels to take care of actual exact positioning. The attachment of the keep-plate of the lathe cross-slide feed mechanism is a case in point, for clearly the feed-screw will be truly in line with its nut in one position only of the keep-plate. Fortunately, some latitude in this respect is allowable in practice, as a square-thread feed-screw is generally machined so that there is some side play in the feed-nut. Nevertheless, it is often essential to provide for the accurate reassembly of working parts after they have been dismantled for adjustment or cleaning ; it may, therefore, be found helpful by some workers if a description is given of the methods used when fitting register-pins to ensure correct location.

Although parallel register-pins are usually fitted, those of tapered form have some advantages and their use will be referred to later.

The two parts represented in Fig. 1 are located by means of a pair of parallel register-pins, and here, the central screw serves only for fixing the parts together and is not capable of keeping the upper component from moving or turning on the lower when the parts are subjected to stress. Although, for the sake of clarity, the upper part is shown as a plain disc, in actual practice it might be an important portion of a mechanism requiring accurate and firm location on its base. To fit the register-pins in the example illustrated, the two parts are first set in the correct position and then firmly clamped together by means of the central screw ; toolmaker's clamps should also be applied to give greater security and keep the parts from moving while being drilled.

The position of the two pins is next marked-out symmetrically on the face of the upper part, as shown in Fig. 2, and these points are first centre-punched and then drilled with a small centre drill.

These drilled centres are now deeply drilled with a drill of the reaming size for the diameter of the rod chosen for making the pins.

Silver-steel is, perhaps, the best material for the pins, as it is accurate in size and has good wearing properties. The pins, where they are fixed in the material, should engage for at least

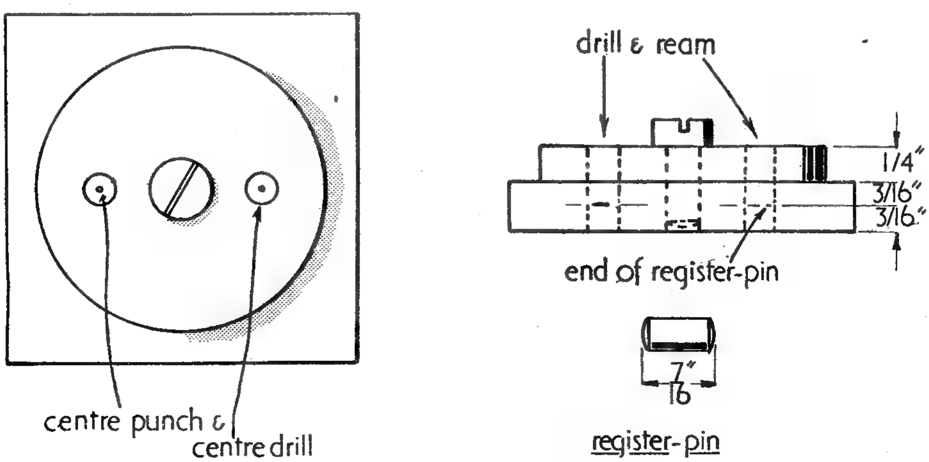


Fig. 2. Left—marking-out for drilling ; Right—drilling and reaming the work

one and a half times their diameter, and the actual diameter should be ample to ensure rigidity and to resist wear. As the tip of a reamer is tapered, allowance must be made for this when drilling, so that there is enough depth to avoid the reamer bottoming in the hole. Reference to Fig. 2 will show that in the example given, using $\frac{1}{8}$ in. diameter pins, the total depth of drilling will be at least $\frac{5}{8}$ in.

component will be a good sliding fit on the pins themselves.

Should there be any doubt as to the squareness of the drilling, it is best to press the pins into place with the upper component removed, otherwise this part may be difficult to separate and hand fitting by enlarging the holes will be needed to allow of assembly and so make the best of a poor job.

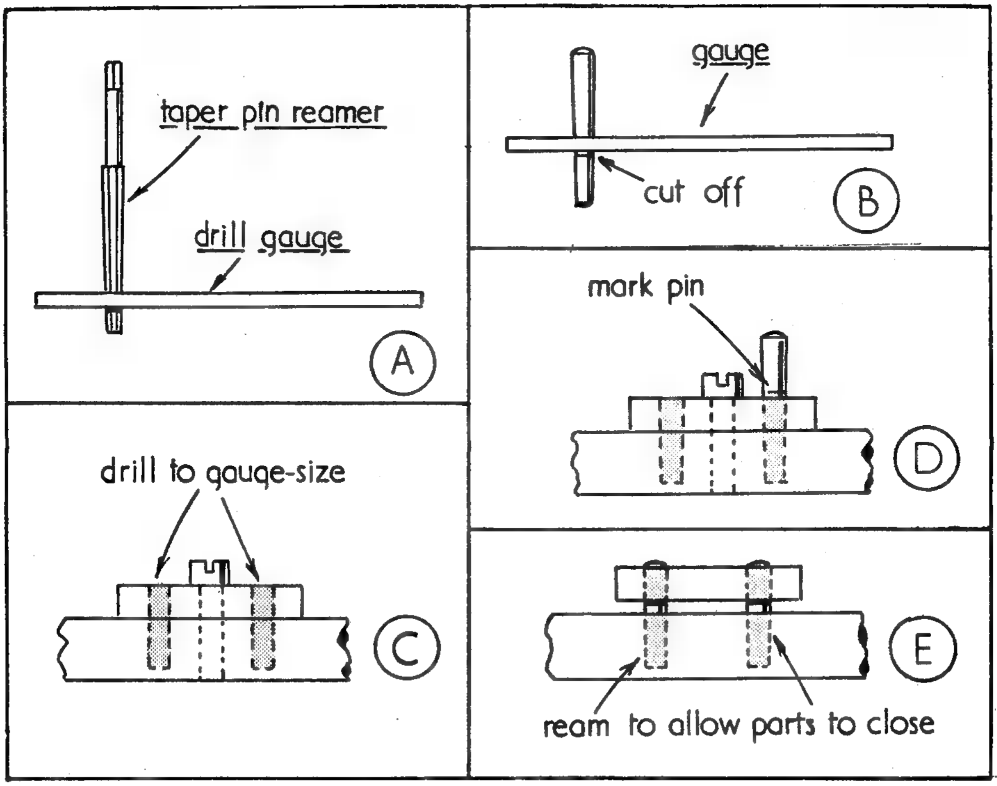


Fig. 3. Method of fitting tapered register-pins

The drill holes are now opened out with the reamer, and, when doing this, the total length of the pin should be marked on the reamer with a grease pencil as a guide to the correct depth of entry. The length of steel rod, after its end has been turned or filed flat and the sharp corner removed, is next pushed into the reamed hole and marked at a point some $\frac{1}{16}$ in. above the surface of the work. After the pins have been cut off to length, their outer ends are slightly rounded by gripping the parts in the drilling-machine chuck and then applying a fine file, followed by a strip of abrasive cloth to give a good finish.

The pins are now ready for insertion and should be pressed home in the vice until their ends are flush with the work surface.

If the work has been carefully carried out and the holes accurately drilled and reamed, the pins will be firmly fixed in the base and the upper

Fitting Tapered Register-Pins

Tapered register-pins are, perhaps, easier to fit than the parallel form, and any errors of fitting or looseness resulting from wear are more readily corrected.

The work is prepared in the way already described, and the size of the drill hole is determined with reference to the taper pin and the corresponding taper reamer.

Insert the reamer in the gauge for number-size drills so that the point just goes through, as represented in Fig. 3A. This indicates the size of drill required. Next, as in Fig. 3B, insert the taper pin in the same hole and mark it and cut it off at the point where it clears the gauge. If a gauge of this type is not available, drill a series of trial holes in a piece of sheet metal until one of the right size is found. The holes are now drilled in the work deep enough to ensure

(*Continued on page* 364)

SILVER-SOLDERING FOR MODEL ENGINEERS

by G. T. CLARKSON, F.G.A., C.M.B.H.I.

MANY of the processes and methods in daily use by certain specialised trades would be of the greatest value to the home craftsman if only he knew about them Quite often, it is not that expensive equipment is needed or a high degree of skill required. Silver-soldering as practised by the silversmith and jeweller is a good example of this. Although hard-soldering is used by some model makers, many more would find it extremely valuable if they realised its possibilities and once mastered the simple technique involved. A hard-soldered joint is very strong ; in the case of non-ferrous metals it is practically as strong as the whole metal, and a hard-soldered joint can be made invisible, if required. It will also stand any degree of heat likely to be encountered.

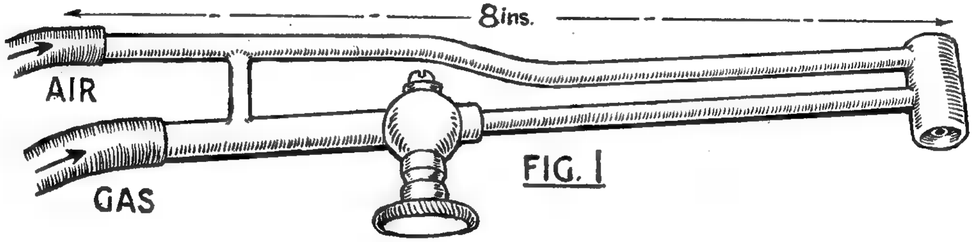


FIG. 1

It is wise for the amateur to confine himself to one kind of silver-solder and there is little doubt that Johnson Matthey's Easy-Flo is one of the most generally useful. It has a comparatively low melting point, will solder copper, brass, nickel silver and steel, and the glassy residue of the melted flux can be removed by hot water, i.e. without pickling in acid. Although it runs at a lower heat than the silver-solders used by silversmiths, whose wares have to stand up to assay for silver content, it still requires a very much higher temperature than is required for soft-soldering, and it is on this point that the beginner is liable to fail. A bunsen flame would give enough heat for most small jobs (and it is only small work we are considering) but the bunsen burner cannot be applied in a downward direction, and this is essential for most work. We shall require, then, a small blowpipe of some sort, and if you can run to buying one, perhaps the most generally useful type is that known as the French blowpipe (Fig. 1). It is not at all difficult to make your own, and instructions have appeared from time to time in THE MODEL ENGINEER. A blowpipe is an absolute necessity for hard-soldering, and indeed, once you possess one you will wonder how on earth you managed without it. It is useful not only for silver-soldering but also for annealing or softening non-ferrous metals (brass, copper, bronze, nickel silver, etc.), and for hardening and tempering steel. It can also conveniently be used for soft-soldering, on the rare occasions when the process is justified. One word of caution here ; hard-soldering is impossible if a trace of soft solder gets on to the job.

We shall need a blowpipe with gas supply, a strip of Easy-Flo and a tin of Easy-Flo flux. For harder silver-solders borax is used as a flux, but the special flux has a much lower melting point, which suits the solder, and it does not require an acid pickle to remove it. We shall also require some support to rest the work on whilst being heated. Sometimes a piece of fire-brick is convenient, or a charcoal block as used by working jewellers, and for some work an open tobacco tin containing broken pieces of fire-brick is a convenient support, or a piece of asbestos board can be used, but in this case see that the piece of board is thoroughly dried out, as it will otherwise explode violently when heated.

For our example of hard-soldering we can take a job the writer has just done. On a skeleton clock which was in for overhaul the top end of the pendulum-rod was very badly shaped. The crutch slot was out of truth and too wide, whilst the slit for the suspension spring ran off to one side. These faults set up a wobble in the pendulum which stopped the clock. It was decided to fit a new top end to the pendulum. The rod was, therefore, sawn off at *A* (Fig. 2) with a jeweller's piercing saw and a new piece of brass sawn and filed to shape, omitting both slots. Even at this stage it was wise to think of how the two parts were to be held together when being soldered. This is often quite a problem but there is always some answer, although the method adopted varies with the kind of job. Sometimes the parts are bound together with soft iron wire (but try to avoid soldering the wire) ; sometimes they are simply laid in position on a charcoal block ; sometimes a split pin can be used as a clip to hold the parts together, whilst on occasion the blowpipe can be held in the vice, the charcoal block in the left hand and the small part to be soldered in tweezers in the right hand. This last is useful when soldering say a small ring or loop to a larger piece. In the case of the pendulum, however, it was decided to make a stepped joint and

rivet the two pieces together with ■ brass pin filed from wire (Fig. 3). This meant that the overlap had to be allowed from the beginning. Before the parts were put together, the mating surfaces were well wetted with flux paste. The Easy-Flo strip used was about 1/32 in. thick, and from it two panels about $\frac{1}{8}$ in. square were cut. These were wetted with flux and one was laid on the top joint line (Fig. 3). It is convenient

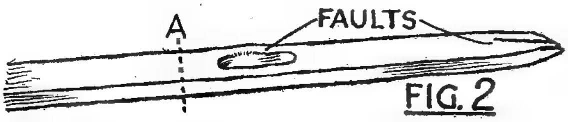


FIG. 2

to use ■ child's painting brush to apply the flux paste, but ■ piece of frayed-out string tied to ■ matchstick will serve. The pendulum-rod was then rested on a charcoal block, which, from previous use, was irregular. This was ■ good thing, ■■ the heat of the flame could get all round the joint. If the block were ■ new one with ■ flat surface, it would be wise to use ■ couple of nails or split pins to keep the rod off the block. The blowpipe flame was then played on the rod, only for ■ second or so, alternately on either side of the joint, to warm the rod and thus dry the flux. This first gentle heating is important, as playing the flame straight on the joint would cause the flux to bubble up and spit off the solder, ■■ warm up very gently until all boiling of the flux has stopped. Even then, the flame should be played on each side of the joint and the heat led up to the joint. Try to delay melting the solder until the rod is very hot, almost red-hot, at and near the joint. Shifting the flame to the joint will then cause the solder to melt suddenly and run right through the joint. The melting solder will always run towards the hottest point, so see that both sides of the joint are equally hot, and also sufficiently hot. Turn the rod over to see whether the solder has run right through; if not, repeat the operation on this side with the second piece of solder. Quench in water whilst still hot, ■■ this helps to remove the flux. The brass pin and surplus solder were then filed off. This gave ■ joint ■■ strong as the rod and to all intents and purposes invisible.

Jewellers generally use tiny panels of solder ■■ above, but silversmiths prefer the strip method, which is better for larger jobs. In this, a thin strip of solder, say, 1/32 in. by $\frac{1}{16}$ in. is cut and held in pliers, after being fluxed at one end. The joint is then well fluxed and heated up—no precautions taken to heat gently at first, ■■ there are no pieces of solder to displace. When the joint is almost red-hot, the solder is heated up in the flame as it plays on the rod and then touched on the joint. The solder will run immediately right through the joint.

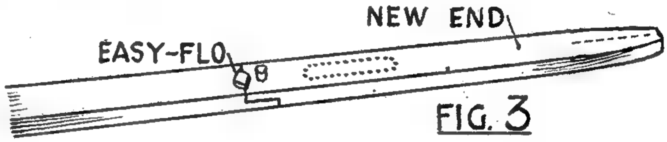


FIG. 3

After the new top was soldered on to the rod, the slit for the suspension spring was sawn out with a jeweller's saw. This cut went off the line—it is difficult to get it dead true—and it was decided to correct it. This was very simple. A scrap of Easy-Flo was filed thin enough to go into the slit, well fluxed and pushed in, then refluxed. The end of the rod was then heated until the solder melted and filled up the slit, when a second and better sawcut could be made. The fact that this was done within an inch or so of the soldered joint gave no trouble, as silver-soldering is very stable and the parts do not drop away when reheated, as they would if soft-soldered. Jewellers often heat up a piece again and again, as when soldering claws to ■ jewel setting and, later, the whole setting to the shank of a ring. It is usual to reflux the old joint when reheating, but quite often the same grade of solder is used throughout the whole job.

It is important that at the moment the solder runs both parts to be joined must be at the same heat, and it follows that if one part is big and heavy and the other part light, the heavy mass must be given very much more heating than the light part.

Novices' Corner

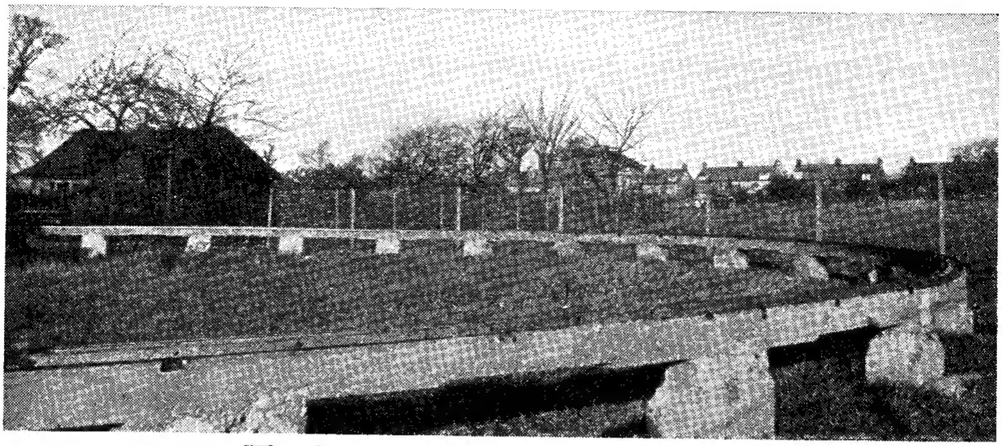
(*Continued from page* 362)

that the reamer will not bottom—Fig. 3C. Mark the pins, as in Fig. 3D, to indicate their finished length, and continue the reaming until the pins will engage to a depth some $\frac{1}{16}$ in. short of what is required.

The upper component is now removed, and the pins are pressed into place in it after they have been cut off to the finished length.

It will then, of course, be found that, with finger pressure, the upper component will not close on the lower by some $\frac{1}{16}$ in., as illustrated in Fig. 3E. To remedy this, the reamer is again applied to the base portion and reaming is continued until the two parts will just fit together. During the latter operation, great care must be taken to keep the reamer square with the work surface, otherwise ■ poor mating fit will result.

Parts fitted together in this way are easy to separate without danger of bending or straining the register-pins. Should it happen that the work has not been done properly and ■ loose fit results, or if slackness has later developed from wear, the holes in the upper component can be enlarged with the reamer to allow the pins to be pressed in further and so fit closely in the holes in the base. If preferred, the two parts can be secured together and the holes reamed afresh; a new and larger pin is then fitted by using ■ portion of ■ similar pin taken from nearer to the large end.



What the driver sees when he leaves Ridgeway station

THE CHINGFORD TRACK

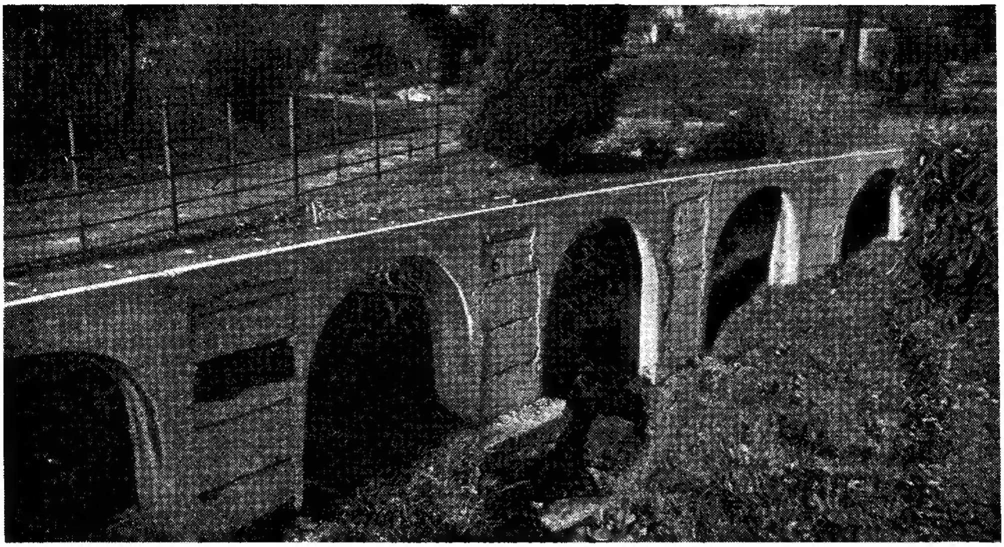
by H.E.W.

THE Chingford Club's outdoor continuous track is one of the major attractions of Ridgeway Park, Chingford. To all intents and purposes it belongs to the club, which is responsible for its maintenance and management, but strictly speaking it has been erected on publicly owned ground in a public park, with the kind permission, and considerable help, of the local authority. I gathered that the local council surveyed the site and provided and erected the concrete pillars on which the track rests, but that Chingford M.E.C. was responsible for providing and laying the actual track, which consists of four rails, giving gauges of $2\frac{1}{2}$ in., $3\frac{1}{2}$ in., and 5 in. The total length of the line is one-sixth of a mile. The rails used are lengths of 1 in. $\times$ $\frac{1}{4}$ in. bright rolled mild-steel, held to gauge by tie-rods and spacers, at short intervals. Originally, the rails were simply laid on the flat tops of the pillars, with no intervening support, and at the present time quite a lot of the original track remains in use. The Chingford drivers, however, found that there was an appreciable sag in the track as the engines and their loads passed over the sections between the supporting pillars, and furthermore the track tended to shift and twist owing to the lack of rigidity in its structure.

It appears that the merry track-men of Chingford then decided that nothing but the best was good enough, and accordingly they set to work to rebuilt their track, and later saw the opening of a considerable length of newly-built track, supported throughout its length on concrete spans between the pillars, and rock-steady, as I can personally testify after having ridden on it: though I must admit that passing from the solidly built " new " sections on to the original portion of the track makes the latter feel very unsteady, especially as the spot where the change takes place is very nearly 5 ft. from the ground! Indeed, it seemed like 10 ft. to me, riding on a narrow board running on bogies behind a long green streak of an engine which seemed to delight in speeds that were rather unnerving to a passenger who was not used to the thrills of this kind of thing.

Talking of thrills, I was chatting with the drivers of some of the engines at work on the sunny Sunday afternoon when this interview took place, and they told me that people who have never experienced any kind of small locomotive running except sitting behind an engine on a perfectly level, straight, up-and-down track, can have very little idea of what this kind of continuous track work can be, and indeed my own experience as a passenger confirms this. Although Chingford was not the first outdoor continuous track I had visited, it certainly was the most exciting and adventurous ride I have ever had behind one of these little engines.

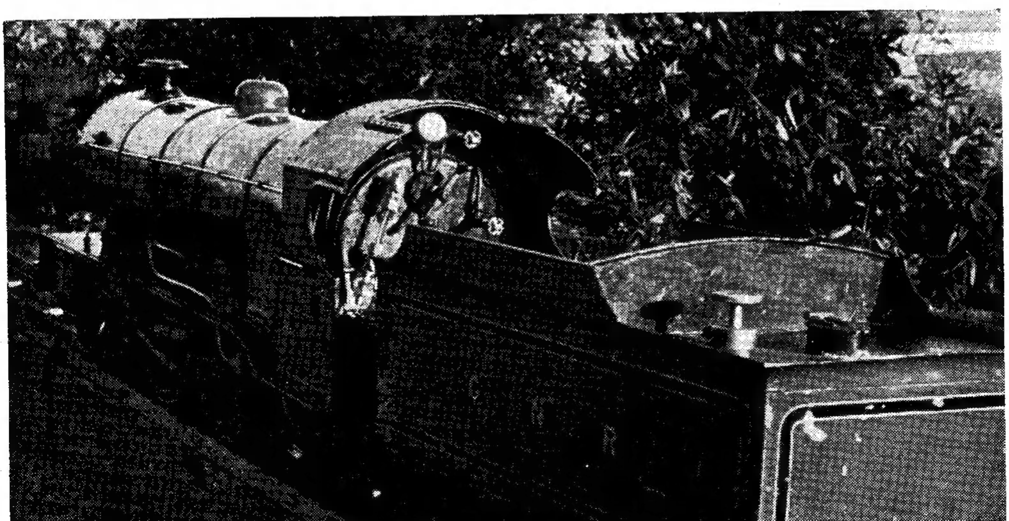
There are several reasons for this. In the first place, the Chingford track winds in and out on a site which provides a variation of scenery of the most fascinating kind. As you leave the station—oh, yes, they have a beautiful little station, complete with a ticket-office, which is used for its legitimate purpose—the track winds round a 30 ft. radius semicircle, only about 1 ft. from the ground, as if it were trying to introduce the nervous passenger very gently to the prospect of thrills ahead. Suddenly we find ourselves riding over a viaduct about 5 ft. high with curved bridge-spans. Then the train passes along about the only straight section, on a rising grade, and still at a most unnerving height, through a woodland stretch, surrounded by trees. At the end of the rise another broad curving sweep takes us round the edge of a large expanse of long grass, quite out of sight of the rest of the railway, and seemingly miles away from our starting point. Soon, however, we find that we are running easily down a gently winding grade with trees skirting the



track, and arrive at the station once more, where the train stops behind another which has just loaded up with eager children.

The Chingford track staff told me that an engine really has to be *driven properly* if it is to pull a load around this track of theirs. Level stretches of the track are the exception rather than the rule; the curves are rather "tight" for engines with long wheel bases, and flange friction—particularly on the heavily loaded truck wheels—is considerable. I should say that anyone thinking of bringing, say, a Pacific-type engine over to Chingford (the Chingford lads are always delighted to welcome visitors, with or without engines) would be well advised to make quite sure that his engine will negotiate a 30 ft. radius curve without derailing. They tell me that several disappointed visiting owner-drivers have been unable to run owing to the inability of their engines to go round the curves of the track.

The Chingford M.E.C. has, until recently, relied upon the engines of their members or visitors to carry out their public obligation and keep the passenger services in operation at the week-ends. They purchased a 5-in. gauge Atlantic engine, and are training drivers, so that a regular schedule can be worked during the season. The ticket office in the station is kept very busy when the track is working, and the entire receipts go to swell the club funds.



The club's 5-in. gauge Atlantic locomotive, "Firefly"

PRACTICAL LETTERS

Offset Right-angled Gearing

DEAR SIR,—*Re* query No. 9884, " Bevel Gear for Right-angle Drive." A suggestion that may help your querist is put forward. Instead of using normal bevel gears, try a contrate wheel and pinion. The pinion being easy to cut can be compensated for the 15 thousandths of an inch offset in centres, by cutting the teeth at a slight angle. If he drew the gears up on an enlarged scale he would see what angle would be necessary. It can also be calculated very simply ; in fact, with contrate wheels it might be possible to run without any compensation for the offset in centres. It will depend upon the use which he has in mind. Hoping this may be of assistance, or, at least, open another avenue of thought.

Yours faithfully,
Weybridge. EWART J. BRIGHT.

Screwcutting Problems

DEAR SIR,—With reference to Mr. S. A. Stead's suggestion for overcoming the problem of the non-" drop-in-anywhere " screw-thread, this can be rendered even simpler by using the tailstock as a stop and running the carriage back to it. The tailstock position should, of course, be ascertained as suggested.

If the proximity of the tailstock to the business end of the lathe is undesirable, a distance-piece can be laid on the lathe bed.

Yours faithfully,
Exeter. W. J. HUNT.

Electrified Fences

DEAR SIR,—With reference to Mr. H. C. Maller's letter in THE MODEL ENGINEER, February 1st issue.

I should like to mention that the contacts on the electric fencer he illustrates would have a very short life, as there is no condenser in parallel with them to minimise the arcing that would take place. I would suggest one in the region of 0.2 mfd. ; this would also greatly improve the output voltage. In fact, very little voltage would be obtained without it.

The use of ignition coils and Model " T " Ford trembler coils is mentioned. The spark obtained from these coils is rather large. The average coil of the present car variety will produce a spark from ½ in.-1 in., depending on the type of coil used, which means 50,000-100,000 volts approx. and the Ford coil slightly more, from what I remember of them. (I quote the figures 100,000 volts per inch of spark, from a back number of THE MODEL ENGINEER.)

The usual spark obtained from a normal type of fencer is about $\frac{5}{16}$ in. ; this is a very elastic figure and varies with the different makes but I quote this as a high average. This represents approx. 31,000 volts which is only used in dry weather, another taping being employed (theoretically) in wet weather, which decreases it considerably.

I am given to understand that certain cattle are very susceptible to even low voltages. If this is so, the use of one of the larger or Ford type coils (I fully appreciate that the current with this voltage is very, very small) would, I am inclined to think, tend to increase the meat ration temporarily. If these coils are used it would be advisable to use them on no more than 4 volts, the coil under consideration normally being, of course, a 6-volt one.

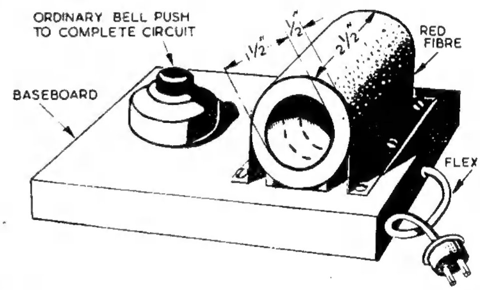
I should have mentioned that a condenser is fitted in the Ford coil and, therefore, another is unnecessary.

Yours faithfully,
Andover. E. G. W. CLARKE.

A Simple Demagnetiser

DEAR SIR,—The following may be of use to our friend H.N., of Normanton (No. 9844), who enquires about a demagnetiser.

I have such a demagnetiser and most useful it is. Recently I had been putting a magneto together and magnetised a handful of tools. They were all demagnetised in a matter of moments.



The coil is, or was, the secondary of a transformer. It is built in five sections with micanite (about 0.05 in. thick) between each pair and is " solidified " in paraffin wax. Its total resistance is 2,000 ohms and is, almost certainly, No. 38 (0.006) single silk-covered wire. I think I am right in saying 13 oz. of wire would be required to make it.

To demagnetise, say, a screwdriver, I put it into the coil, with the current (230 V, a.c.) on, and withdraw it slowly along the axis, taking perhaps five seconds in moving it 2 ft. The solenoidal pull tells me that the current is actually flowing.

Yours faithfully,
Lymington. A. RICKARD TAYLOR.

Preparing Cast-iron for Machining

DEAR SIR,—In the issue of THE MODEL ENGINEER for February 1st, 1951, Mr. W. J. Saunders gave some tips on " Machining Cast-Iron."

I had to face flat some castings which had a very hard skin. Chipping off the scale would not solve the problem, as the castings were circular, and difficult to hold in the vice.

I thought I might dissolve away the skin, so

the castings were put into strong hydrochloric acid (spirit of salt) and left for a time.

It was found that a vigorous action ensued, and the outer skin was vigorously attacked. I then washed and dried the castings and put them aside until they were to be worked.

Upon proceeding to machine them, it was found that the hard skin was loosened, and readily came off in flakes exposing the normal iron beneath. It seems that the hard skin has porous places which permit the acid to act beneath it, and push it up, or crack it off.

This method would appear to be worthy of a more extensive trial; an old glass accumulator tank or cell would form a convenient vessel to contain the pickle; it would take a time in accordance with the characteristics of the iron immersed in the acid, and the strength of the acid.

Yours faithfully,
Mill Hill. H. H. NICHOLLS.

A Sturdy Veteran

DEAR SIR,—I was pleased to note from the letters published on January 11th that several other old Drummond $3\frac{1}{2}$-in. lathes are still in regular use.

With regard to the question of the change-wheels, asked by Mr. Mather, I have now been in touch again with Mr. Chambers, and he says that his full list of change-wheels is as follows :—

Iron wheels. Four with 20 teeth; four with 30 teeth; one each 35, 38, 40, 45, 50, 55, 60, 63 teeth.

Boxwood wheels. One each 18, 19, 21, 24, 25, 36, 48 teeth.

The latter were all made by Capt. Tresidder, but Mr. Chambers cannot say whether the others are the complete original set issued with the lathe. However, it would appear that Mr. Mather has quite a few missing!

As to motorisation, the lathe is *still* foot-treadled, but from an earlier experience of my own I should imagine that the $\frac{1}{4}$-in. round belt would not be too satisfactory if and when Mr. Chambers does decide to motorise.

Yours faithfully,
Sheffield. W. J. HUGHES.

(We have been able to publish only a small proportion of the letters which have been received on this subject, but we thank our readers for the interest taken, and the information which has been brought to light concerning these popular lathes. The correspondence on this subject is now closed.—ED., "M.E.")

Correction

With reference to our review of the Ferguson Propane gas-heating torch in the issue of THE MODEL ENGINEER dated February 15th, we regret that an error occurred in the name of the manufacturers, which was given as British Cutting Gases Ltd., Mill Lane, Lymington, Hants. This appliance is made by Messrs. Ferguson Bros. (Johnstone) Ltd., Rankine Street, Johnstone, Renfrewshire. British Cutting Gases Ltd., however, can supply the cylinders of Pyrogas which are recommended for use with this appliance.

Club Announcements

Glasgow Society of Model Engineers

The next meeting will be held within the society's rooms at 60, Clarendon Street, Glasgow, N.W., on Saturday, March 17th, at 7.30 p.m. Members of power boat section should make an effort to attend; subject, "Power Boat Review."

Visitors will be welcomed and particulars of membership can be had from the address below or at the rooms, 60, Clarendon Street, Glasgow, N.W., which are open Thursday, Friday and Saturday from 7.30 p.m.

Secretary: ALLAN RODGER, 93, Ormonde Avenue, Muirend, Glasgow, S.4.

The Coventry Model Engineering Society

A pleasant evening was spent recently when a film show was given by the Central Office of Information, and the meeting was open to ladies and friends.

The following meetings have now been arranged :—

March 16th. Film show by Mr. D. Gardiner. (Member.)

March 30th. Lecture, "Valve Gears in Use Today," by Mr. D. Masters. (Member.)

April 13th. Film show, "Plastics."

April 27th. Lecture, "Signals and Interlocking Frames," by F. Renshaw.

Meetings are held at the B.T.H. Social Club, Holyhead Road, Coventry, at 7.30 p.m.

Hon. Secretary: L. J. BEDDER, 105, Butt Lane, Coventry.

Romford Model Engineering Club

At the recent annual general meeting, Mr. P. Dupen, winner of the locomotive championship cup at the last MODEL ENGINEER Exhibition, was elected hon. secretary. The retiring secretary, Mr. C. Wilkins, was elected vice-president in recognition of his services to the club.

On March 15th, Mr. T. S. Lascelles, of the W. R. Sykes Interlocking Signal Co. Ltd., will give a talk on the technique of modern railway signalling, illustrated with slides. April 5th will be a competition night.

Both meetings will be held at the Lambourne Hall, Western Road, Romford, and will commence at 8 p.m.

Hon. Secretary: P. DUPEN, 48, Rockingham Avenue, Hornchurch, Essex.

The Model Engineering and Hobbies Club

We have again changed our quarters; this is, we hope, a more permanent abode. The members helped materially to rebuild the actual room, turning their hands to bricklaying and glazing with a will, but even before the interior decoration had been half completed the members had broken loose and unleashed their pent-up energies in modelling, which had been denied them for quite some time.

Now, however, we are reasonably settled in and modelling which, incidentally, consists of railway engines mainly, is carried on in some greater degree of comfort than was before possible.

Hon. Secretary: R. JESSON, 129, Third Avenue, Bordesley Green, Birmingham, 9.

York City and District Society of Model Engineers

The next meeting of the above society will be held on March 17th in No. 8 room, Co-operative Buildings, Railway Street, York, at 7 p.m.

Hon. Secretary: K. VAREY, 75, Hempland Lane, Heworth, York.

The Tyneside S.M.E.E.

The next meeting will be held at the headquarters of the Newcastle-upon-Tyne Photographic Society, 6, Rutherford Street, at 2.45 p.m., on Saturday, April 7th, when a lecture entitled "The First Four Years" will be given by Capt. W. H. Day.

Hon. Secretary: L. JAMIESON, 34, Dorcas Avenue, Pendover, Newcastle-upon-Tyne, 5.

Preston and District Society of Model Engineers

At the recently held annual general meeting of the above society the following new officers for 1951 were elected: Chairman, Mr. J. Banister; secretary, Mr. F. L. Smith; treasurer, Mr. R. Walker.

We have a very active year in front of us with work on the club locomotive and locomotive track outstanding. It is also hoped to organise a few lectures during the year.

Meetings are now held on alternate Friday evenings at Amis Cafe, Friargate, Preston, at 7.30 p.m.

Hon. Secretary: F. L. SMITH, 59, Duddle Lane, Bamber Bridge, nr, Preston, Lancs.